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THE EXPORT OF ELECTRICAL APPARATUS.

The year's trade balance has just been struck, with exports $666,457,103 in excess over imports with a total of $1,194,341,904. This is the largest excess of exports that the trade of the country has ever seen, although 1901 approached the same figure within a couple of millions. As a matter of fact, and as might have been expected in a year of financial disaster with falling prices, the figures of foreign trade were smaller than in recent years of great prosperity, imports being actually $240,000,000 less than in 1906-7 and exports $20,000,000 less. The decline was chiefly in food stuffs, with a slight decline in manufactured articles. On the whole, the figures show the ability of the country to hold its own, and to ship produce against gold in moments of emergency. With lower imports this year and large crops, an equal or better showing may easily be made; but all would welcome a return to the larger figures of international trade, reaching $3,315,272,503 in 1907.

The complete figures of electrical export are not yet to hand for the year, but those of May and of the 11 months indicate totals quite a little below those of 1907, unless there was a great and unexpected rally in June. The export of electrical instruments in May was $619,393, or $155,279 less than last year. The export of electrical machinery was $800,566, or $331,478 less than before. These are perceptible declines, but the totals for the 11 months loom up in about the same ratio. Electrical instruments fell off $1,175,879 in the period and machinery $89,084. Hence the grand total is $14,218,207 as compared with $15,433,170, or a loss of $1,214,963. This would be serious but for the known conditions of the period. It might even be said that the difference in the value of raw copper alone would account for most of this. Believing that with returning prosperity the old levels can be reached and soon excelled, we can but urge, as before, on our manufacturing friends the wisdom of an energetic policy that will build up a seaborne trade, desirable at all times as increasing the volume of product and thereby decreasing costs; and also as an outlet for surplus goods in the recurring seasons of depression.

It will be interesting to see the effect on export trade of such patent laws as have recently been instituted in England compelling a patentee to "work" in that country in order to keep his rights alive. Possibly we may run into an era of retaliatory measures of this kind that will in the end lead to the abrogation and nullification of such laws; but meantime it looks as though American articles protected in England by patents will also have to be English in actual manufacture. We have already given some details as to this important legislation, but as it does not go into effect until the end of the present month, no one can yet say just what the effect will be. But at first glance, it does look as though a check must be administered to patent articles; though, again, it will not be altogether easy to discover for some time what that means. Most electrical ex-

ports, we imagine, rest for their market and their customers, less on patent protection than on quality, cheapness and intrinsic desirability.

The Portable-Substation Locomotive.

One of the most interesting types of electric locomotives in existence at the present time is the portable-substation locomotive with which the name of Ward Leonard has been associated for many years. Although this type has not been given a serious trial in this country, it has been introduced with success elsewhere, as may be noted from an article by Mr. Frank Koester in this issue. A prominent advantageous feature of the locomotives described by Mr. Koester resides in the use of direct-current motors supplied with energy at variable voltage without rheostatic loss, and the elimination of the numerous periodically-idle substation that would be required where the standard direct-current trolley equipment is installed. By employing such a locomotive the number of substations required is reduced to that actually in service when the locomotive is loaded, but the remaining substation must be extremely rugged in order to withstand the mechanical abuse involved during transportation. To just what extent the portable-substation locomotive will prove superior or inferior to the older direct-current, or to the newer single-phase, equipments, only a long series of competitive tests can determine; but the fact that the general scheme has been retained for further investigation after four years of severe experimentation would indicate that the portable-substation arrangement possesses features that may prove of advantage in heavy electric traction.

Not the least interesting part of the Seebach-Wettingen railway system is the overhead catenary line construction, which may be looked upon as the result of development and evolution during four years of service under intelligent supervision. For the purpose of obtaining the required flexibility and of maintaining the alignment, use is made of an auxiliary catenary which serves for supporting the contact wire and in turn is supported from the main catenary wire. Experience on railways where rigid suspensions have been employed has shown conclusively that a considerable range of flexibility must exist between the contact wire and the moving current-collector if high speeds are to be obtained. The scheme of suspension described in this issue has been applied on several railways, and seems to have proved successful. A difficulty encountered with rigidly-aligned contact wires by reason of the excessive temperature changes to which they are subjected has been avoided in the present instance by the use of a so-called give-and-take device which maintains a certain tension upon the wire irrespective of the expansion and contraction during hot and cold weather. Since gravity alone is depended upon to furnish the tensional force in the wire, there can be no doubt that the desired stress is obtained at all times, while the various mechanical and electrical details involved in supporting and insulating the self-tightening overhead structure seem to have been worked out in a thorough manner.

Miscellaneous Central-Station Service.

The relatively recent activity in extending central-station service to miscellaneous uses is in strange contrast to the policy which for a long time confined the output of central stations to electric lighting alone. So far at least as concerns electric power, there appears to be no reason why the development of this branch of central station business should not have commenced 20 or more years ago, and it is astonishing that even at the present day a very considerable proportion of plants have not yet got earnestly to work building up a motor load. Among the causes for this singular apathy are probably that lack of direct competition which to most men is necessary to incite activity and keep them out of ruts, and neglect to analyze costs, which analysis would have removed the terror of cutting the cent-per-lamp-hour rate to a horse-power-hour basis rendering a motor load possible. In recent years the example of a few energetic spirits who have brought central station economics to a highly satisfactory state, the friendly rivalry among more enterprising central station managers as to the adoption of up-to-date methods, and keener competition from the gas interest, which long ago adapted ordinary commercial methods to its business, have tended to correct the complacency of those who stood pat on an exclusive franchise to supply electrical service; while the extensive literature that now exists as to rate systems and the rational determination of proper charges for exceptional service, as well as the object lesson of central station properties transformed from non-paying to profitable plants by abandoning the former "standard" charges which did not take into consideration the relative cost of various classes of service, have been unheeded only by the old guard who still regard as ideal the happy days when the electric light man wore a halo and disdained anything smacking of commercialism.

A report printed elsewhere of the electrical features of a recent meeting of the National Association of Dentists illustrates the spread of miscellaneous applications of electricity. While many of the devices exhibited require little current for their operation, every one should be a source of some profit to a central station, and therefore no more to be disdained than the sale by a merchant of minor articles adding little to the total of sales. In addition to the benefit of minor applications in advertising electrical service and rendering its capabilities familiar to the widest extent, the effect in seeking such business will stimulate the central-station man to efforts in other directions. In particular, the long line of electrical heating and drying apparatus now available for dental work should turn attention to similar applications of electric heat to larger industrial uses, such as desiccation and baking of enamels on smaller metal parts. In brief, no electrical application should be ignored by the central-station man on the score of its relatively small use of current, or because "local conditions" do not appear to render it available. In the latter case particularly, a first use should be forced, if for no other immediate reason than to add to the reputation of the company for up-to-date enterprise.

Symbols for Physical Quantities.

Every student of electrical engineering text-books, and indeed every student of applied science in any of its numerous branches, comes in contact with the inconvenient fact that in some writings a certain physical quantity, such as an electric resistance, say, is denoted by R, while in other writings, particularly German literature, resistance is denoted by W. Of course, this difference in symbols is attributable to the fact that in the German language electric resistance is expressed by the word *widerstand*. When a certain system of symbols is adopted in a technical text-book for a given series of physical

quantities, if any one deviation occurs from this system in another text-book, there will be at least one more deviation involved thereby. Thus, in English text-books *W* commonly stands for work or energy. If a German text-book takes *W* for resistance, then it follows that in addition to deviation on the resistance symbol, there will also be deviation on the energy symbol. It is like taking pairs of gloves from a stock on a shelf. If we once remove a discrepant pair, then there will be trouble with the pairs that are left, and it will be fortunate if in future we escape with but one more discrepant pair.

In order to avoid the inconvenience and upheaval of mental concepts involved by changing symbols and their implications when changing text-books, many attempts have been made in the past to inaugurate an international physical notation. This suggestion has always received most hearty support from specialists, or engineers in definite branches of applied science. It has received only lukewarm adherence from physicists, mathematical chemists and men whose intellectual interests extended over large areas. This is probably for the reason that in the English language we have, including capitals, lower-case letters, and script, only 78 symbols to work with. If we add 50 Greek symbols, including both upper and lower cases, and also 50 German symbols, we arrive at a total of 178 symbols. This is not nearly enough material for the general physicist, or mathematically-minded technologist, to work with. His array of physical concepts available for use is much greater than can be presented in such a list, even if every letter could be assigned to duty, which is not easy to arrange. Consequently, the general worker in mathematically applied physics dislikes to limit himself officially to a vigorous alphabet, because he feels sure that he will have to break the rules offered to him for subscription. On the other hand, however, the mechanical, electrical or civil engineer deals ordinarily with a more limited series of physical quantities, and his particular series is capable of being accommodated by a more limited font. For example, in ordinary electrical engineering, considered from the practical standpoint, there are not more than about 60 physical quantities dealt with, while many engineers deal only with about 30. Just in proportion, however, that an engineer is selective in his working formulas, do these formulas gain power, significance and practical importance. They become the very tools of his work. Their symbolic entity is significant to the man who is constantly employing them. The engineer is thus particularly interested in keeping his formulas under the same symbolic apparel in all the text-books that he consults.

At the International Electrical Congress of Chicago in 1893 a committee was appointed to consider international symbols and nomenclature. That committee adopted the Hospitalier notation and reported the same to the congress. Differences of opinion were, however, manifested in the congress as a whole, and finally it was decided to print the notation recommended as an appendix to the congress proceedings, without any formal adoption of them. Since that date, the Hospitalier notation has been generally adopted in North America. Thus *I* has been very generally used for current strength and *C* for capacity. At the Official Scientific Congress of St. Louis in 1904, in connection with the World's Fair, an attempt was made to secure international action. A joint committee was appointed from the various engineering and applied science societies in North America to meet representatives of similar societies from other countries. A meeting of the various delegates was held, but it proved nugatory and was devoid of effect, apparently for the reason that the representatives of the various European scientific societies were nearly all eminent scientists of wide mathematical interest, as distinguished from engineers with narrower but more intensely definite mathematical interest. The engineers and technologists seemed to be nearly unanimous in favor of an international alphabet or sets of alphabets for physical quantities. The scientists were, in general, opposed to such action.

The article by Mr. Miles Walker, on page 282 of this issue, raises the same questions again. We agree entirely with him as to the importance of adopting a uniform international system of notation for physical quantities used in applied science and engineering. We consider that such an international system can only be arrived at by mutual compromise. At present, we have three distinctive sets of notation, namely, one in England, one in Germany, and one common to France, the United States, Belgium and Italy. In addition to these, there are numerous subclasses and variants in all of the above countries. It would be far better to have one and the same set for all engineers. It can be introduced by mutual discussion, forbearance and sacrifice. We do not, however, support the plan suggested by Mr. Walker of a set of new symbols, forming a virtual new sign language, like that of the Aztecs. If there were no other possible solution of the difficulty, then Mr. Walker's method would be worth entertaining as a last resource. There are two objections to his method. First, that it involves the maximum amount of disturbance in all engineers' metal associations, by introducing a new series of symbols, all of which would have to be learned afresh, even if it be granted that all are selected in a suggestive manner. Secondly, we all know how hard it is to have compositors set up formulas correctly, using the familiar and well-known alphabetical signs. We know the time and expense and annoyance involved in such composition. If we introduce this new font of picture-symbols these difficulties will be further increased.

In our judgment the right way to attack this problem of international notation is along the line of minimum intellectual disturbance. First adopt internationally those few symbols which are common to all or nearly all countries. Then, with these as a nucleus, build up a system of the minimum necessary number of engineering symbols, according to the most general usage, from a world standpoint. It will not be necessary, at all events, for the first decade, to adopt more than about 60 physical quantities, and the regular fonts of Roman and script, supplemented by German and Greek, will suffice. If later on it should be found that more are needed, then let Russian, Hebrew or picture signs be included, but we doubt any such necessity. The main difficulty will probably be met in establishing the first six symbols internationally. We want no picture signs for these. Let us commence upon the easiest. Letters will certainly serve. Once the first six have been adopted, and put into force internationally, there will be no trouble about the rest. But let us adopt no more than engineers must have. We are certainly indebted to Mr. Walker for agitating the discussion of international symbols, even although we dissent from his suggestions. We shall be glad to receive further suggestions from our readers either in the form of articles or by way of our correspondence columns.

International Conference on Electrical Units and Standards.

An international conference on electrical units and standards will, on the invitation of Great Britain, assemble at Burlington House, London, in October. The general object of the gathering is to consider and advise as to the steps which should be taken to bring about an agreement in the definition of electrical units which form the basis of legislation in different countries, and in the method of constructing and employing the electrical standards necessary to give effect to these definitions. The delegates will embody their conclusions in draft articles for the consideration of the various governments with a view to uniform legislation. The conclusions arrived at by the representatives of the various national standardizing laboratories who met in 1906 will be brought forward as a basis for discussion. They are also generally in accordance with the decisions of the Chicago Congress, held in 1893. The more important are as follows:

(1) That the ohm shall be the first primary unit; (2) that the ampere shall be the second primary unit; (3) that, in consequence, the volt shall be treated as a secondary or derived unit; (4) that the international ohm be defined as the resistance at the temperature of melting ice of a column of mercury of uniform cross section, terminated by planes at right angles to its length, 106.3 centimeters in length and 14.4521 grammes in mass; (5) that the international ampere be defined as the unvarying electrical current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0.001118 gramme per second; (6) that the international volt be defined as that electromotive force which, when applied steadily between the ends of a conductor, of resistance the international ohm, produces a current of the international ampere.

Symbols for Physical Quantities.

By Miles Walker.

It is very desirable to have a notation for the representation of physical quantities in scientific books and periodicals which shall be the same in all languages. The subject is under the consideration of the International Electrochemical Commission with a view to international agreement, and committees in the different countries (in England under the chairmanship of Lord Rayleigh) are discussing this particular subject. They are dealing more especially with symbols for electrical and magnetic quantities, but the system might with advantage be extended to embrace all important quantities in physical science, especially as the subject is receiving the attention of most technical societies with a view to some action being taken in the matter.

There are, however, two great difficulties which arise when we try to fix upon a standard notation.

The first is the difficulty of persuading a number of writers and readers who have become accustomed to a certain symbol for a certain quantity to change it in favor of an equally large number of writers and readers who have become accustomed to another symbol. For instance, in France and Germany the letter I commonly represents the strength of an electric current, while in England C is more commonly used.

In the second place, there are not enough letters in the two or three alphabets at our disposal to give a distinct symbol to each quantity, without resorting to the combination of more than one letter to form a single symbol. There is a great objection to this combination of letters, because the use of subscript letters and numbers is required for distinguishing between particular quantities of the same general kind. If, for instance, C represents current, C_a might conveniently represent armature current, and C_1 the current in circuit No. 1. It would, therefore, not be good to take C_a to represent capacity, or any other quantity other than an electric current.

There is, moreover, an objection to using letters at all to represent quantities in a universal notation, because, unless initial letters are used, there is no connection in the mind between the letter and the quantity and the symbol is difficult to remember. We cannot always use initials because the initial letters differ in different languages. For instance, in England R commonly stands for resistance, while in Germany it is more convenient to use W for *widerstand*. Moreover, the same initial occurs for a great number of different quantities. For instance, R might stand for resistance, reluctance, reactance, radius, etc.

One way of avoiding the above difficulties would be to create a number of new symbols which could be printed by means of type like ordinary letters, and which would represent each physical quantity in a distinctive manner.

The question, however, arises as to whether a number of entirely new symbols would be acceptable to writers, readers and printers alike, and the sub-committee on symbols appointed by the British section of the commission has requested the writer to place his views publicly before the profession with a view of obtaining suggestions and criticisms as to the feasibility of such a scheme from as wide a circle as possible.

In choosing a symbol we would try to make a very simple picture of something that reminds us of the quantity in question. For instance, ⌊ might represent temperature. If we were told that this simple outline of a thermometer represents temperature, we would have no difficulty in remembering it. Similarly / might represent force, and the various "forces" might be derived from it; for instance, ϟ e.m.f. (conventional representation of lightning); and ∩ m.m.f.

It is not my purpose here to say what would actually be the best form of symbol for each quantity, but it is not a difficult matter to devise very simple characters which can be written quickly, easily and with sufficient accuracy, and which can at the same time assist the memory to connect them with the quantity for which they stand.

What would the printers say to the new type? The author has taken up this matter with a very large publishing firm and is assured by its chief expert that 200 or 300 new type would be a small matter to a modern printer, who is already accustomed to deal with many hundreds of different fonts, each of which contains from 80 to 120 different symbols. He estimates that a printer in a large way of business has at his command as many as 60,000 distinct type, differing from each other either in letter, size, body or face. The addition of 200 or 300 more would be a drop in the ocean. The size of the new type could be standardized for most purposes, and it would only be in some special case that another size would be called for.

The setting up of the formulas with the standard size of type would be simpler than with the present system, in which subscript letters are often unnecessarily introduced. One symbol under the present system sometimes consists of four or five letters.

If it be admitted that the introduction of new symbols is advisable, the question arises what shall the new symbols represent exactly? Shall the sign ⌊ (Temp.) represent temperature in any units or shall it represent the number of degrees of temperature, measured by some scale agreed upon and embodied in the definition of the symbol? If the system of units employed be not prescribed, fewer symbols would be required, and the general writer who now says vaguely "Let T equal the temperature," would find the symbol sufficient for his purpose. But from the reader's point of view there is much to say in favor of a symbol which will embody in its definition a standard system of units. Any formula expressed in such symbols would be completely self-contained and would be an exact statement of a physical fact. Until the units employed in any formula are known, the formula expresses only half its meaning. Perhaps some slight addition to the symbol, or even to the whole formula, might be used to indicate that the standard system of units is employed. Without that addition, the symbol would have a general meaning. For instance, ⌊ might equal temperature, while ⌊ might indicate the degrees Centigrade above the absolute zero. The name of the type might be the name of the physical units which it represents; for instance, ϟ we might read volts.

If writers, printers and readers who have any definite views

as to the best method of devising a system of symbols would communicate with the technical press or with the author, they might assist in solving the many difficulties which arise in connection with this matter.

Electrical Development of Plant Life in England.

Sir Oliver Lodge has recently made public an account of his studies and experiments during the past two years in the application of electricity to the development and improvement of plant growth on a farm in the Midland Counties. The experiments follow up the well-known work of Lemstrom and appear to be quite encouraging; in fact, they are being repeated at the present time. The work has been carried on by Mr. Lionel Lodge at the farm of Mr. R. Bomford, of Salford Priors, with the co-operation of Mr. J. E. Newman, of Gloucester.

As described by Sir Oliver Lodge, the method is to stretch over the field to be treated a number of wires on poles, something like low telegraph wires, but high enough for loaded wagons to go underneath the wires without let or hindrance. The wires are quite thin, and are supported by a few posts in long parallel spans, about 30 ft. apart. They are supported on the posts by high-tension insulators, and extend over all the acreage under experiment, a control plot of similar land under similar conditions being, of course, left without any wires. The system of conductors is then connected at one post with a generator supplying positive electricity at a potential of something like 100,000 volts, and with sufficient power to maintain a constant supply of electricity at this kind of potential. Leakage immediately begins, and the charge fizzes off from the wires with a sound which is sometimes audible, and with a glow which is visible in the dark. Anyone walking about below the wires can feel the effect on the hair of the head.

The electrification is maintained for some hours each day, but is shut off at night; it is probably only necessary to supply it during the early morning hours in summer time, and in spring time or in cold, cloudy weather for the whole day, or during the time of the plant's greatest activity. But at what stages of the growth of a plant the stimulus is most effective has still to be made out. However, in the case of wheat both the ear and the straw are valuable, and the electrification is accordingly applied for a time each day during the whole period of growth until stooling begins. The power required to generate the electricity is very small, for although the potential is high the quantity is insignificant, and the energy is accordingly comparatively trivial.

The power is generated by a two-horse oil engine driving a small dynamo in an outhouse of the farm. Thence the electrical energy is taken by ordinary overhead wires to the field, where they enter a suitable weather-tight hut, which contains the transforming and rectifying apparatus. The transformer is a large induction coil, specially made to stand continuous use, and its current is then rectified by means of vacuum valves in accordance with a patented device invented by Sir Oliver.

The negative electricity is conveyed direct to earth, while high-tension electricity, all of positive sign, is led by a specially insulated conductor out of the shed to the nearest post of the overhead insulated wires, which are thereby maintained at continuous high-positive potential.

The overhead system of wires covered about 19½ acres of ground. The wires were mounted on insulators placed upon larch poles some 15 ft. high, which were placed in rows, the rows being separated by a distance of 102 yards, the poles in a row being 71 yards apart. Telegraph wire carried the current down each row, while thin galvanized iron wires, placed some 12 yards apart, were stretched between the rows, and acted as the discharge wires. In this way 22 poles were sufficient to support the wire over the 19 acres. Roughly, only one pole per acre is required; therefore, the inconvenience is practically nil. Owing to the flexible suspension, risk of breakage to the wires is very small. During the two years the wires have been up at Bevington, apart from a few wires broken at harvest time by catching in the tops of extra high wagon loads, only one wire has fallen.

As to the actual results obtained in 1906-7, it is stated that Canadian Red Fife wheat electrified showed an increase of 39 per cent, and English White Queen 29 per cent, with a corresponding but not measured increase in the quantity of straw. The electrified wheat sold at prices 7½ per cent higher, and baking tests showed an average of dry glutens in the electified of 11.15 per cent as compared with 10.25 in the unelectrified.

In 1907, in a wheat test, the electrified showed 41.4 bushels per acre as compared with 32 from the unelectrified portions of the field; and the electrified wheat was a better and brighter sample. Strawberries showed a 35 per cent increase and earlier ripening. Mangolds showed an estimated increase of 25 per cent, with an increase in the sugar. Small plots of raspberry canes showed a marked improvement in growth, and some plots of tomatoes gave a large increase in the crop.

Electricity Supply for London, England.

After a hearing of 30 days, a committee of the House of Lords, presided over by Earl Cromer, has just sanctioned the bill of the London & District Electricity Supply Company, which proposes to establish large generating works on the lower Thames for the purpose of giving a bulk supply to the smaller generating plants and systems at present scattered throughout the London area, numbering no fewer than 76. The bill has now to face the House of Commons. The joint engineers of the scheme are Mr. H. F. Parshall and Mr. Robert Hammond. This case has been dragging along for some months, and the general idea has been before the public for years.

Three measures have been before the House of Lords, the first being that which has now received approval. Its plan includes the whole of the great Administrative County of London, i. e., the boroughs over which the London County Council has jurisdiction, together with the city area. The promoters also asked for powers to supply various authorities outside that area, as far east as Tilbury and Swanscombe, and extending west to Ealing and Kingston, north to Enfield and south to Croydon. The scheme is (1) to supply in bulk to authorized companies, and to permit authorized companies to take supply from them; (2) to purchase existing plants; (3) to supply railways within or without the area; (4) to supply in areas where there is at present no authorized undertaking; (5) to go into the area of an authorized company and, with the consent of the authorized company, to supply a consumer there with energy if the demand exceed a certain limit. If the authorized company or authority, in such a case, refused, the District Company has asked to be allowed to go to arbitration; and if the authorized company would not supply as cheaply as the District Company, the bill asked that the District Company might then supply.

The second bill is promoted by eight of the existing supply companies in London. They propose to supply any authorized distributor of electrical energy within the Administrative County of London, and they seek powers within an area which circles the county through Hendon, Walthamstow, Barking, Chislehurst, Croydon and Richmond, the whole being somewhat less in extent than the area scheduled by the District Company. The eight companies do not seek for powers to compete in any district, and they do not propose in any way to come between authorized companies and their customers. As the more important of the eight companies have already six large stations in various parts of the area, they wanted permission to link up between them. When so linked up they would have had immediately available 10,000 kw from spare plant, over and above their present requirements. This part of the plan was seriously modified and restricted in committee. Lastly, there is the bill of the Westminster and Kensington group of electric supply companies, promoted by five companies, including the Central Electric bulk

company, which was formed to supply the Westminster Company and the St. James' Company in bulk, and which has a generating station in Marylebone. They now seek powers to link up the Wood-lane generating station—a joint power station, owned by the Nottinghill Electric Lighting Company and the Kensington & Knightsbridge Electric Lighting Company, and they also seek powers to supply each other. The area concerned is chiefly residential, with comparatively small demand for electricity for power purposes.

Under its bill as adopted by the lords' committee, the London District Electricity Supply Company is authorized to spend $30,000,000 and the engineers are now getting out plans for a 120,000-kw station.

Notice Served on Economic Power & Construction Company by New York Commission.

The New York Public Service Commission, Second District, served notice on July 23 on the Economic Power & Construction Company to answer within 20 days a complaint filed against it by the Geneva-Seneca Electric Company. The Economic company, which claims the right under its charter to operate an electric lighting plant and sell current in Geneva, N. Y., without the approval of the commission, has secured an order of court restraining the commission from proceeding in the case. The writ was issued by Supreme Court Justice George H. Fitts, at Albany, and is returnable Sept. 26. The complaint of the Geneva-Seneca Electric Company, signed by A. H. Jackson, its president, states in part:

"The complainant alleges that said Economic Power & Construction Company claims to be a domestic corporation organized by and under Chapter 459 of the Laws of 1893 of the State of New York, and claims to have authority under said statute to lay down, erect or maintain wires, pipes, conduits, ducts or other fixtures, in, over or under the streets and public places of the city of Geneva, for the purpose of furnishing, transmitting and distributing electricity for light, heat or power, without obtaining any consent from the municipality and without obtaining the consent and permission of the Public Service Commission for the Second District of the State of New York.

"That during the month of February, 1908, said Economic Power & Construction Company applied to the Board of Public Works of the city of Geneva for the use of certain ducts in the conduit system of said city, to be used for conveying electric current. That said Board of Public Works thereafter granted said application, and on March 9, 1908, passed a resolution that a contract, as approved by the Board, be executed by the Mayor, and thereafter and on March 9, 1908, said alleged contract was executed by the Mayor of said city and delivered to said company. That by said alleged contract, said Board of Public Works leased and granted to said Economic Power & Construction Company permission to occupy with electric wires two ducts in conduits located in certain streets of the city of Geneva, for the purpose of the transmission of electric current by said Economic Power & Construction Company, and in and by said alleged contract, said Board of Public Works further granted to said Economic Power & Construction Company the right to connect its electric system with the premises thereby leased and to extend laterals under the sidewalks to private property. It was further provided by said alleged contract that said Economic Power & Construction Company should not be required to pay rent for connections and extensions made by it, and that any wires thereafter used by said Economic Power & Construction Company for the transmission of electric current within said city would, at the request of said Board of Public Works, be placed in conduits where conduits were suitably located for the reception of such wires. It was further provided in said alleged contract that said Economic Power & Construction Company should furnish to the city of Geneva without charge 100 kw of electric current per month, and that the prices to be charged by said Economic Power & Construction Company to each customer for lighting within said city should not exceed the rates mentioned in a schedule of prices contained in said alleged contract, without the written consent of the Board of Public Works."

The complaint also states that when the Economic company made application to the Board of Public Works it commenced the construction of an electric lighting plant, and later began to construct its lines and to construct and lay its wires and cables in the conduits in the street. It was also complained that the Economic company has never obtained any franchise from the city enabling it to exercise any right or privilege in connection with the supply and furnishing of electric current therein.

The complaint further alleges "that by reason of the acts and omissions aforesaid, said Economic Power & Construction Company has violated and is now violating the following provision of Section 68 of Chapter 429 of the Laws of 1907, known as the Public Service Commission's Law, to wit: 'No gas corporation or electrical corporation, incorporated under the laws of this or any other state, shall begin construction or exercise any right or privilege under any franchise hereafter granted, or under any franchise heretofore granted but not heretofore actually exercised, without first having obtained the permission and approval of the proper commission.'"

At the meeting of the City Council of Geneva on July 28 no bids for the city lighting were received. The Geneva-Seneca Electric Company announced that it would carry out the proposals at such figures as might be set by the Public Service Commission in each instance and that the company would apply to the commission without expense to the city to have the prices fixed. The Economic company stated that it "had expected to make a proposal for lighting the streets and public places of the city of Geneva, but after consideration finds that it will not be justified in making a proposal for a five-year contract from Jan. 1, 1909, on account of the litigation which has been instituted by the Geneva-Seneca Electric Company and others against the company. We are confident that we shall succeed in maintaining the validity of our charter and legal rights and confidently expect to have the decision of the Court of Appeals in our favor within the next eight months, and we would respectfully request that at this time the city of Geneva accept proposals for a one-year contract instead of a five-year contract."

No action was taken by the City Council on the subject.

Advanced Degrees in Electrical Engineering.

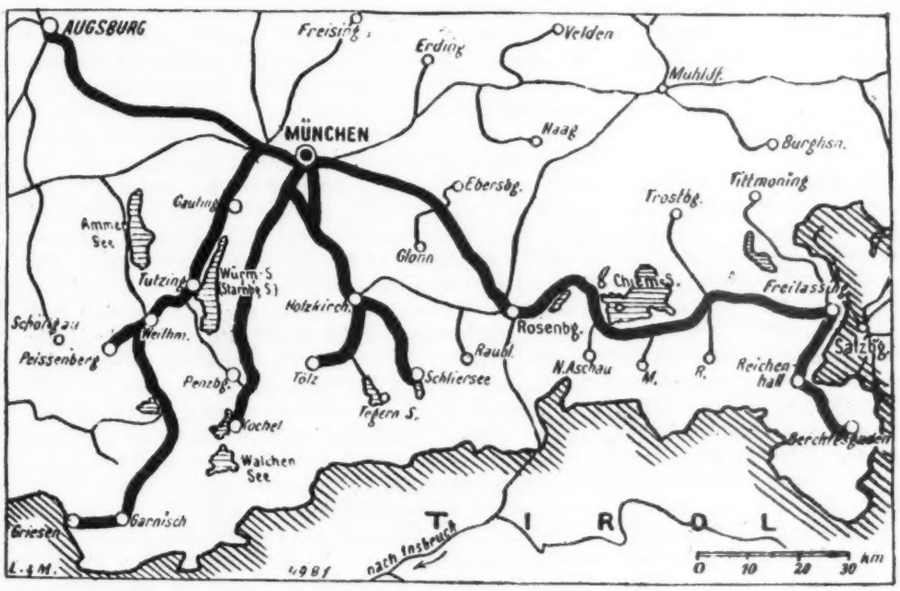
The demand for young men with a more extended and a deeper training in electrical engineering theory than can be obtained in an undergraduate engineering course has led the Massachusetts Institute of Technology to emphasize its graduate courses. These courses lead either to the degree of master of science for young men who propose to spend one year of advanced study of electrical engineering or to the degree of doctor of philosophy or doctor of engineering for young men who are able and propose to spend longer periods in their advanced study and research. The degrees of master of science and doctor of engineering are particularly applicable to students following electrical engineering studies; and lectures, seminars and other advanced instruction for students who are candidates for the doctor's degree will be well under way in the electrical engineering department during the next school year. In addition to students who will follow the course leading to the degree of master of science, candidates who will follow the work leading to the degree of doctor of engineering have already arranged to begin this work at the Institute next fall. The advanced work leading to the doctor's degree may follow in its major part either the lines outlined by Professor Jackson's lectures on the "Organization and Administration of Public Service Companies," or by Professor Clifford's advanced course on alternating currents, as the individual student may choose; and it is expected to be accompanied by such other work as may be chosen by the individual student (subject to faculty

approval) from other departments of science and engineering.

It is believed by the faculty of the Institute that engineering students of particular ability can well afford to spend from one to three years of special advanced study under competent instructors along the lines of engineering theory and practice, and that such students will profit largely from the results of such study. Indeed, this seems to be proved by the experience of numbers of engineering students who have gone through courses of such advanced study either in this country or abroad. The advanced courses in electrical engineering at the Massachusetts Institute of Technology are planned particularly with a view to meeting the needs of such students as have hitherto found it necessary, or supposed it was desirable, to go to foreign countries for advanced engineering instruction.

Electrical Equipment of Railroads in Germany and Austria.

The well-known experimental runs in Zossen a few years ago, when speeds above 200 kilometers per hour were made by the electrical locomotives of the Allgemeine Elektricitats Gesellschaft and the Siemens & Halske Company justified the opinion that the Royal Prussian Railway Administration, which organized these experiments, would soon introduce electrical traction on some of the main Prussian State Railway lines. Thus far, however, with the exception of some suburban lines, nothing has been accomplished in this direction. Thus in Hamburg two tracks out of four are electrified. Those two are for local or suburban traffic, while the other two tracks, which are for through traffic, continue to be used by steam locomotives. On the Berlin Stadtbahn, similar conditions prevailing, the electrification of the two local tracks is being considered. In Hamburg this work was completed about a year ago.



MAP OF GERMAN AND AUSTRIAN RAILROADS.

Coal is more expensive in Germany than it is in the United States, and in the last few years prices have been increasing in an alarming way. Along the above mentioned railway there are great deposits of lignite which cannot be used for locomotive firing, but which can be utilized for the generation of steam in specially constructed stationary boilers. This fact, together with the steep mountain grade on that line, made electric traction an attractive proposition from an economical point of view. The reason why this scheme was laid aside seems to have been the veto of the war department. The line in question is near the border and has a great strategical value. By destroying the power house the enemy could, in case of war, bring the entire traffic to a standstill and, in any event, could cripple the service by the destruction of one point of the transmission line.

Very recently plans were published, according to which the authorities are considering at present the electrification of the main line from Leipsig to Bitterfeld (128.1 km) and from Leipsig to Halle (36.2 km). The reason for this choice is that there are considerable lignite deposits in the neighborhood; also, these lines are in the interior, so that probably there will be no objections against it from the military authorities. High tension single-phase will be used on these lines.

In the kingdom of Bavaria the government has of late been giving much attention to the matter of electrification and has recently published the results of an investigation extending over the entire Bavarian State Railway system. It is estimated that in the year 1906 the railways would have required 517,839,000 kw-hours. This includes all the state railways in Bavaria proper, but not those in the Pfals. It is further estimated that generating stations with an aggregate rating of 606,000 hp would have been necessary in 1906, and the country possesses sufficient water-power to cover the entire amount.

Of course, however, only economical considerations can justify electrification, that is, those lines must first be electrified where water-power is cheapest and coal most expensive, and also where the density of traffic is comparatively great. The investigation has shown that in the southern half of the country, near the slope of the Alps, electrification is more economical for lines of small density of traffic than it would be for northern lines with much greater density, but where long transmission lines would be required, as the water-powers are nearly all in the Bavarian Alps. In some instances the density of traffic in northern lines should be twice as great as in southern lines to get the same economy. The critical price of energy per kw-hour in the south is between ¼ and ½ cent, against ¾ cent in the north.

It is the intention to equip electrically the lines shown in black on the accompanying map. A beginning will be made with the line from Salsburg through Reichenhall to Berchtesgaden and from Garnisch to Griesen. Also on a new line which is being built between Garnisch and Scharnik. For the fast passenger trains, locomotives with four pairs of driving wheels will be built which are capable of moving a 175-ton train with a speed of 80 km per hour. The mountain grade of 4 per cent between Kirchberg and Hallthurm, which has a length of 5.7 km, can be run with a train of 90 tons at a speed of 30 km per hour. The weight of the locomotive is not included in the above train weights. The schedule running time between Salsberg and Berchtesgaden will be shortened by 35 minutes.

The Bavarian Government proposes an expenditure of $1,435,000 during 1909 for the first instalment of the railway electrification. The e.m.f. will be 10,000 volts and single-phase will be used throughout, which is also the case in Prussia. (It will be remembered that the original Zossen experiments were made with three-phase.) For the generation of electrical energy the Bavarian Government proposes to build the following three stations in the near future:

(1) The Saalach station, which will cost $500,000, and will sell its energy to factories, etc., until the time arrives when the railways require the full output. The line from Salsburg to Berchtesgaden will obtain its energy from this station; however, it requires only 660 hp (average load). Without taking the cost of electrical energy into account, a saving of $20,800 per year will be made on this line by its electrification, which means that the cost of a kw-hour may amount to 1.2 cents, to make the cost of both methods of operation equal.

(2) The Lech station, which will have 21,000 hp. The cost will amount to $1,500,000.

(3) The Walchensee station; power, about 50,000 hp; cost, $5,500,000. This will eventually feed energy to the electrified lines near Garnisch. The Bavarian Government will make the plan of this water-power development the subject of an international competition, and in the meantime will obtain its energy from an Austrian station for the Garnisch division.

It is also the intention of the Austrian Government to electrify the connecting railroad across the border near Garnisch, and the Nuets station near Innsbruch is to provide the energy on both sides of the frontier.

The reason why the Austrian Government is seriously studying the electrification of the state railways in Tyrol and the other Alpine provinces is the abundance of water-power, heavy grades and the increasing cost of coal. The Austrian Government pays at present 64 per cent more for its coal than it did a few years ago. In the Alpine provinces the cost of transportation of coal is also a heavy item in connection with the heavy grades. For the Arlberg division the cost of transportation is $1.85 per ton. While in Bavaria the government reserved the important water-powers for its own use and intends to keep them as state property as they are necessary for the state railways, the Austrian Government intends to have the water-power stations built by private companies and to be merely a customer of them.

Two years ago a commission was appointed to ascertain which water-powers were necessary for the railways. The policy of the state railway administration is now to obtain franchises and transfer these to private companies on condition that the state railways can obtain energy on favorable terms.

It is evident that the different policies of the Bavarian and the Austrian state railways are due to the different laws of these countries. In Austria the state railways must obtain franchises from the state and have no advantage whatever above their competitors who are looking for the same franchises. In order to make matters easier the state railway administration tries to reach agreements with the competitors as outlined above. In Bavaria the state owns the railways and water-powers just as is the case in Austria, but here it does not seem necessary for one state department to try to obtain a franchise from some other state department without having any advantage above private parties. Therefore the state railways in Bavaria have the immense advantage of obtaining energy without legal or other difficulties. Though economical necessity will probably force both Bavaria and Austria to electrify those lines which are located in or near the Alps, it is probable that the first electrification of through railways in Central Europe will take place in Bavaria.

The Austrian Government spent $35,000 in 1907 in preparation for railway electrification, and on the budget of 1908 an amount of $75,000 has been set aside for the same purpose.

200,000-hp Norwegian Nitrogen Plant.

The company which is working the 40,000-kw hydro-electric plant at Notodden, Norway, for the fixation of atmospheric nitrogen by the Birkeland and Eyde process, will shortly make an addition of no less than 200,000 hp to its manufacturing capacity. The present plant produces nitrites for the textile industry, and the new plant will manufacture nitrate for agricultural purposes and also nitric acid. The present plant, which consists of four 10,000-kw generators, has been very successful in its technical operation, while the product has been disposed of at a profitable price almost invariably in advance of production.

The Law of Electromagnetic Induction.

A paper read by Mr. Carl Hering at the Atlantic City convention of the A. I. E. E. was devoted to a discussion of the "looping" vs. the "cutting lines of force" expressions of the fundamental law of electromagnetic induction. Descriptions were given of an experiment devised to test the accuracy of these expressions. (See Electrical World, March 14, 1908, page 558.) The experiment showed that the change of flux enclosed in a circuit cannot by itself be the prime cause of the e.m.f. produced in the circuit; the production of e.m.f. is localized, and takes place only in that part of the conductor which moves relatively to the flux.

DISCUSSION.

Dr. Chas. P. Steinmetz, in a written communication, said that while Mr. Hering's experiment is interesting in showing an instance of a closed electric circuit in which the number of interlinkages with the lines of force changes without producing an electromotive force, it is not startling, as the reverse case, the electromagnetic production of an electromotive force, in a closed circuit, without any change of the number of interlinkages of the circuit with the magnetic flux, is illustrated by practically every unipolar machine. Faraday's expression, of cutting of lines of magnetic force by the conductor, is the general law of electromagnetic induction; but in its application to unusual cases it must be kept in mind that the "line of magnetic force" is merely a pictorial representation of the magnetic field in space, as characterized by the two constants, intensity and direction.

Dr. A. E. Kennelly stated that in Mr. Hering's experiment the boundary of the circuit is cut at one point, and simultaneously a second circuit embracing flux is introduced at the gap, in such a manner that by sliding along the boundaries of the second circuit, the magnetic flux may be caused to disappear from the embrace of the first circuit without any intersection of flux by the edge of that circuit. This is juggling with terms, just as though the circuit were cut and then reclosed through a quiescent loop linked with a magnet. Manifestly, no current would be produced in the galvanometer by reason of that change, although in one sense of the word "circuit," all of the flux in the loop has suddenly been introduced into the circuit. The experiment is instructive in showing that when the ordinary proposition is enunciated concerning the production of e.m.f. by change of flux enclosed in a circuit, it should be borne in mind that the circuit is not to be juggled with by interrupting it and changing it from a simply-connected to a multiple-connected space. It must consist of a single continuous boundary which, if it moves, moves continuously through simply connected space.

Prof. Elihu Thomson expressed agreement with the views of Dr. Kennelly. By passing the spring-clip over the magnet leg the circuit is virtually opened so far as magnetic induction is concerned, and an immovable section of conductor is substituted in the gap where all of the flux to be cut then exists. There are innumerable phenomena to confirm the conclusion that the real physical substance of the circuit (the matter of the circuit) must cut or be cut by the lines. The experiment of Mr. Hering will tend to clear up matters which have troubled students in unipolar induction.

Prof. W. S. Franklin expressed his belief that those who accept Maxwell's generalization of the "law of magnetic induction" have not forgotten the conception of the actual cutting of lines of force by the material of the electric circuit. However, they are likely to be led to forget it because of the form of Maxwell's statement of the generalized Faraday law.

Mr. Percy H. Thomas said that Mr. Hering's experiment is not conclusive because in drawing off the loop, the lines of force may be said to be still within the loop so long as the ends are rubbing on the sides of the magnet. When the ends come

in contact preliminary to their separation from the magnet, the galvanometer becomes short-circuited and protected from any influence of a latter change of lines in the loop.

Prof. W. P. Graham offered the following explanation of Mr. Hering's experiment. As soon as the copper strips strike the iron, the original circuit, made up of copper strips and galvanometer, is opened, but a new circuit including copper strips, magnet iron and galvanometer is established. And as long as the copper strips make contact with the magnet, there is no change of flux through this new circuit. When the strips leave the magnet, this new circuit is broken, and the old circuit from which the flux has been removed after opening it, is re-established. A more accurate statement would perhaps be that as soon as the strips strike the iron, the old circuit is opened and a new circuit established, to be followed by an infinite succession of other new circuits as the strips slip over the iron, and that the flux is removed from each one of this succession of circuits, by opening each in turn, and establishing its successors; but that there is no change of flux through any individual circuit of the series so long as that circuit is closed.

Mr. George T. Hanchett pointed out that in the Hering experiment there is no unlinking of the magnetic and electric circuits, but rather a mechanical unlinking which deceives the eye. Electrically, the circuit is linked with the magnet, then a new portion of circuit is added in the form of the magnet limb itself, which is ingeniously caused to do all the linking. Next, the original circuit, now free from flux, is removed.

Fixation of Atmospheric Nitrogen.

A patent was issued July 28 to Dr. C. P. Steinmetz on an apparatus for manufacturing nitrous compounds from atmospheric air. It is stated that heretofore it had been deemed necessary to establish each of the numerous arcs required in the fixation of nitrogen from the atmosphere, either in an independent circuit or in a separate branch of the main circuit, thus necessitating great expense for apparatus and much complexity. The potential of the arc circuit is necessarily high, as the longest possible arc is aimed at, and for mechanical reasons the arc must be established without actual initial physical contact of the electrodes. For independent arc circuits, therefore, it is necessary to have either a high-potential generator with a great number of generating coils, or a low-potential generator with many independent generating coils, and in addition thereto as many independent step-up transformers. When the arcs are placed in multiple branches of a high-potential circuit, it is necessary to equip each branch with a reaction coil in order to prevent one arc from short-circuiting from the other, which coils are nearly, if not quite, as expensive as independent transformers.

The invention of Dr. Steinmetz involves the use of a three-phase generator of medium potential and a single three-phase step-up transformer having independent secondary windings for each phase divided in open sections, which sections are closed upon each other by two arcs for each section, so that all the arcs fed by one phase are in series. When these arcs are broken, those fed by the next phase of current are established and these, in turn, are replaced by the arcs fed by the third phase. In this manner, it is stated, an ordinary three-phase generator and a single three-phase slightly modified transformer take the place of the complicated apparatus formerly used.

Great Northern Railroad Cascade Power Plant.

The construction of the power plant of the Great Northern Railroad, which will supply power to the three-phase Cascade tunnel section of the line, is now well under way. The dam across the Wenatchee River in the Tumwater Canyon, Chelan, Wash., is finished, and the pipe line to the power house is now under construction. The dam is 600 ft. long, although the river at the point where it is erected is only about 100 ft. wide; the dam is thus diagonal to the stream, which disposition was adopted in order to have a less depth of overflow at high water. The pipe line consists of 10,954 ft. of wooden conduit and 700 ft. of steel conduit. The latter section leads to the power house, where the head is over 200 ft. The power house will be a three-story building containing three Pelton wheels, each driving a 4000-hp, three-phase generator. Current will be generated at 6600 volts and stepped-down at sub-station at the eastern portal of the tunnel to 2200 volts.

Comparative Cost of Telegraph Service.

Consul George A. Bucklin, Jr., of Glauchau, has compiled from the statistics of the German government the following data concerning the extent and cost of telegraph service in the most important countries:

	Number of messages in millions.	Average cost per message.	Total receipts.	Miles of line.	Average income per mile.
United States	65.5	$0.42	$27,985,000	1,155,480	$24.20
United King	94.	0.16	15,247,000	384,109	39.69
France	58.	0.12	7,334,000	389,002	18.82
Germany	52.5	0.15	8,299,000	458,358	10.10
Austria	19.	0.14	2,702,000	133,549	20.22
Italy	16.	0.21	3,472,000	128,582	27.00
Spain	5.	0.32	1,640,500	47,923	34.23

Statistics of Russia, Japan and other countries are incomplete. The German telegraph system charges are 50 pfennigs (11.9 cents) on messages of 10 words or under to any part of Germany. For each additional word 5 pfennigs (1.19 cents) are charged. Thus 13 words were paid for in the average German message in 1906. The higher average cost for the United States is partly due, of course, to the greater distances over which messages are transmitted.

CURRENT NEWS AND NOTES.

WIRELESS COMMUNICATION WITH BALLOONS.—A recent dispatch from Berlin mentions successful wireless communication between the motor-balloon of an airship battalion and a terrestrial station. It is stated that several messages were exchanged in the course of an hour's aerial flight.

BUFFALO POWER-LESS.—Buffalo was entirely cut off from its supply of electrical energy from Niagara Falls for a few hours on the night of July 25. During most of that time the city was without electric light and street-car service. The suspension of the supply was due to a break in the transmission lines of the Canadian Niagara Power Company, resulting from a storm. Energy from the Canadian company's plant was being transmitted to Buffalo while repairs were being made to the tunnel of the Niagara Falls Power Company, and it was during this time that the break occurred.

A CABLE JUBILEE.—Fifty years ago, August 5, witnessed the successful completion of the Atlantic cable, and 10 days later the President and Queen Victoria exchanged cordial and congratulatory messages over the long line of submerged wire. This is a notable jubilee week, therefore, and commemorates a great event in human history. It is true that failure and interruption impended and that for some years the cable carried no message under the sea; but the real beginning of ocean telegraphy fell in this week of 1858, and the importance of the incident was duly recognized at the time on both sides of the Atlantic.

NOTES FROM EUROPE.—In regard to Dr. Louis Bell's interesting notes from Europe, of recent date, we are informed by the Allgemeine Elektricitaets-Gesellschaft that his reference in our issue of June 27 to the "new Siemens-Schuckert single-phase railway" at Hamburg is not quite accurate. The railway belongs to the Prussian State Railway system. The firm of Siemens-Schuckert has constructed the greater part of the power station and the overhead line. Of the 60-car equipments which the railway now possesses, 54 have been supplied by the Allgemeine Elektricitaets-Gesellschaft; and a short time ago another order for 24 car equipments was given out to the same corporation. The Siemens-Schuckert firm has supplied six of the car equipments.

DIRIGIBLE AIR CRAFT.—Arthur E. Sargent, an inventor of New Rochelle, N. Y., is stated to be working on the details of a balloon which will be directed by wireless means, no person accompanying the craft on its flight. One of its applications is inteded for war purposes in dropping explosives on the enemy and taking photographs.

THE NEW ENGLISH PATENT LAW.—A special dispatch from Berlin states that a German-American patent alliance against the new English patent law, which will go into effect Aug. 28, may be the outcome of the hardships imposed by the new law. It is stated that influential American manufacturing interests and the German Industrial Union may unite for this purpose.

110,000-VOLT TRANSMISSION.—The transmission line of the Grand Rapids-Muskegon Power Company, between Croton Dam and Grand Rapids, Mich., is now operated at 110,000 volts. The distance between the points is 40 miles and the former transmission voltage was 72,000. No trouble has been experienced with the higher voltage since operation commenced the third week in July.

ELECTRICITY IN FARMING.—Mr. Thomas W. Lee, formerly general passenger agent of the Delaware & Lackawanna Railroad, is cultivating almost entirely by electric power a tract of 3000 acres in the vicinity of Idaho Falls. By means of a portable reel of conductors connection can be made at various points to supply mains for almost any agricultural operation, including haulage of crops from field to barn.

ELLSWORTH (ME.) POWER PLANT STRUCK BY LIGHTNING.—During a severe thunderstorm which occurred at Ellsworth, Me., on July 30, lightning entered the new plant of the Bar Harbor & Union River Power Company and burned out the armature and field of a new 1500-hp generator, causing about $5000 damage. The generator was to have been used on that date for the first time to transmit hydro-electric power to Bar Harbor. It is expected that the work will be delayed possibly two months on account of the accident.

PUBLIC UTILITY REGULATION AND BOND VALUES.—In a circular offering for sale the bonds of a New York State electric company, Spencer Trask & Company, the well-known Wall Street bond dealers, offer as a further inducement to prospective purchasers the following considerations: "Another feature in connection with these bonds which should add to their attractiveness to individual investors is the fact that in common with all other public utility corporations in the State of New York the properties are under the regulation and supervision of the Public Service Commission."

INTERNATIONAL TELEGRAPHIC UNION.—The recent meeting at Lisbon of the tenth conference of the International Telegraphic Union recalled the curious fact that the United States does not belong to the union, the only other exceptions among important countries being China and Mexico. In all 46 countries are members, and while the United States regularly accepts an invitation to send delegates, these have no vote, though by courtesy taking part in discussions. The reason for this anomaly is that the other countries control the telegraphs, and the United States could not impose on the American telegraph companies the regulations which may be adopted at the conferences.

STREET RAILWAY PENSIONS.—Receiver Frederick W. Whitridge, of the New York City Third Avenue Railway, has issued a circular to employees of the line proposing the foundation of a pension fund. Each employee is to contribute 50 cents a month to the fund, and the railway company will contribute an amount equal to the aggregate of these payments. The fund will be administered by a board of seven, three of whom shall be employees. The money which goes into the fund will be used to compensate men who are ill, the allowance to be $1.50 a day. This is to begin at once in cases of serious illness or accident, but only after five days in cases of slight illness. The fund is to be used, too, to make payments to the families of men who die while in the employ of the company and to establish a pension system.

GROWTH AT BIRMINGHAM, ENGLAND.—The plans of the corporation of Birmingham, England, for an increase of plant are so extensive as hardly to justify the prevalent notion that electrical development in England is arrested. The city now seeks permission to exercise borrowing powers to the amount of $1,250,000 for electricity supply purposes, the larger part of which will be devoted to power plant, increasing the generating capacity and the substation equipment. It is proposed to spend $100,000 for electric motors and $20,000 for meters. The motors are rented to customers who do not wish, or cannot afford, to buy. In the last two years a motor capacity of 1650 hp has been let out on hire. The Local Government Board of England has already acquiesced in the expenditure of about $1,100,000 of the above amount. Large economies are expected for the additions to the plant.

NEW TYPE OF CYLINDER LIGHTNING ARRESTER.—A patent was granted July 28 to Mr. Maurice Milch on a new type of cylinder lightning arrester. The principle consists of having the surfaces of opposing cylinders in whole or in part of a different metal, as shown in the accompanying illustration, where the plain circles or portions of circles represent iron as material and the hatched circles represent brass. It is stated that this difference in the character of the arcing materials gives to an arc playing between the cylinders a resistance or counter e.m.f. which is different for different directions of the current. The spark-gap may, in a certain sense, be thus termed an asymmetric conductor, permitting the flow of current in one direction more readily than in the other. This phenomenon is utilized in the invention, it is stated, to insure more certain interruption of the arc or of discharge current when the direction of potential across the gap reverses.

THE BECQUERELS.—M. Jean Becquerel, who has recently made an important contribution to the theory of electrons, is of the fourth generation of a family celebrated in the history of science. To the founder, Prof. André Becquerel, known as Becquerel ainé, who died in 1888, at the age of 90 years, we owe the theory of electrolytic polarization, the double-fluid primary battery and other notable contributions to electrochemistry. His son, Prof. Edmond Becquerel, known as Becquerel fils, was the writer of the first systematic treatise on electrical science, and one of the founders of the art of electro-deposition. Prof. Henri Becquerel, son of the latter, and known as Becquerel jeune, is the founder of the science of electroactivity. The affixes to the several names were given prior to the death of the elder Becquerel in order to distinguish the contributions of members of three generations contemporaneously engaged in scientific investigation.

AUSTRIAN ELECTRIC CABLE ROAD.—It is announced from Vienna that the Koller Railway, constructed on the suspension principle, will shortly be opened for passenger traffic. The line is 1640 m in length, and climbs the steep ascent of Mount Koller at a gradient of from 60 to 70 per cent. The whole journey will occupy 14 minutes, and the carriages, constructed in the step form (each section at a different level), travel with perfect steadiness. The wire rope used for traction purposes is 0.62 in. in diameter, and has a tensile strength equal to 22,000 lb., whereas the entire weight of the carriage, with from four to six passengers, does not exceed one ton. For extra security the carriage hangs to a second rope, 0.78 in. in diameter, and the two ropes together are capable of bearing a strain of from 88,000 lb. to 110,000 lb., or from 40 to 50 times the maximum normal load. The electrical energy (40 hp) is taken from the Zwölfmalgrein power station. The trains will run at such intervals as the traffic may demand.

Decorative Lighting in Brazil.

ON the occasion of the fiftieth anniversary of the inauguration in 1858 of service on the Central Railway of Brazil, the officers, wishing to promote a jubilee worthy of the event, opened a retrospective exposition and illuminated the headquarters of the rolling stock department at Engenho de

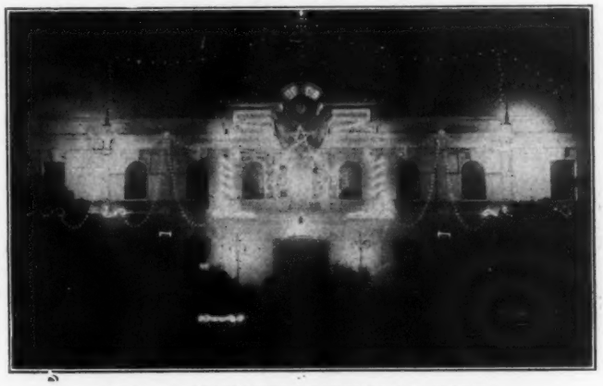


FIG. 1.—DECORATIVE LIGHTING IN BRAZIL.

Dentro. The latter place is 6 miles from Rio, and is destined to become in the near future the nucleus of a great many industries.

Electrical energy for illumination was obtained from a generating plant used for supplying electricity to motor-driven machine tools in the railway workshops. The illuminating scheme adopted was to follow the general style of the architecture without keeping too closely to its outlines.

Tin-plate ribbons, provided with 16 weatherproof miniature sockets, already connected in series and prepared for 220 volts, reinforced by steel wires, form all the luminous ornaments visible in Fig. 1. The 14-volt 2-cp lamp gave satisfactory results, notwithstanding the fear that such a weak illuminative power would be ineffective. All of the festoons on the front of and above the building are made of these small lamps, red colored for the upper decorations and transparent for the lower ornaments and the columns.

FIG. 2.—NERNST LAMPS ON POST; ARC LAMPS ON ROOF.

A good effect was obtained by surrounding the initials E. F. C. B. (Estrada de Ferro Central de Brazil) with these ribbons, placing green lamps on the shadows and yellow on the luminous part of the letters.

The Brazilian emblems formed the principal motive of decoration. The main star is of copper leaf. In the copper are cut the little stars of the Southern Cross and the 20 stars of the States. The stars are made luminous by six tantalum lamps placed inside and a garniture of grounded glass. The five points are accentuated by luminous ribbons, respectively green and yellow. The surrounding parts are of carved wood executed in the workshops. Luminous rays, serving really the purpose of conductors, for the different signs complete the whole.

Seventy-four tantalum lamps illuminated the significant dates 1858-1908, shades being used to protect the edges of the numerals and render them perfectly legible to the eye.

At either side of the principal entrance there are two posts, each of which supports four Nernst lamps. These posts, which are shown in detail in Fig. 1, were designed and built in the workshops.

Four 12-amp flaming arc lamps are used for the general lighting of the edifice. They are supported by decorative arms which, having been made in the workshops, have some particular features described below.

The conditions to satisfy were the following: (1) High suspension on account of the very strong intensity of the light. (2) Necessity of good illumination of the façade of the building, which required the lamp to be placed under the top cornice—allowing the luminous rays to be thrown straight down. (3) Easy refilling of carbon and inspection.

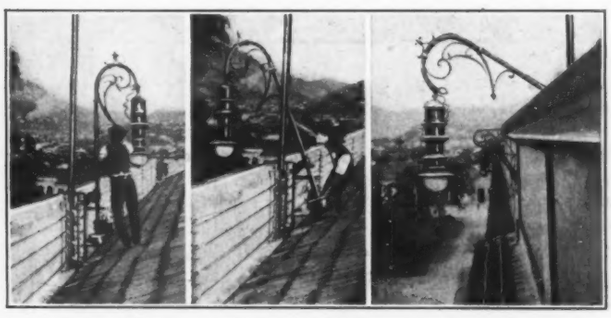
The use of a ladder for the latter requirement was out of the question and the ordinary cable suspension was judged unsuitable. The problem was solved by the electrician in the manner shown in Figs. 3, 4 and 5.

The arm is pivoted, and by means of a counterweight, the lamp is lifted by one man until the arm stands vertically; a rotatory movement afterward makes the lamp come on the roof, as conveniently hung for inspection as on a test bench.

Two luminous fountains were placed in the center of the garden, which formed the background of the building, the dark foliage making a pleasing contrast with the brilliant multicolored water-jets. Current for the two 30-amp arc lamps at the fountains was obtained from a booster.

Finally the park itself was lighted by six 12-amp flaming arc lamps, hung on 10-meter posts, and the light was so clear and well distributed that in any place of the 4500 sq. meters illuminated, it was quite easy to read a paper. Under the vault formed by beautiful trees, in one of the principal alleys, fifteen 1-amp Nernst lamps hung amidst the branches, contributed with the luminous fountains to the fairy-like appearance of the place.

On account of the use of high-efficiency lighting units, all of the electricity for the display was supplied by a 30-kw dynamo. The organizer of the celebration was Mr. J. J. da Silva Freire, sub-director of locomotion. The project was designed and carried out by Mr. Geo. Ruffier, in charge of the electrical department. The decoration of the posts and suspension arms was designed by Mr. E. de Martilly.



FIGS. 3, 4 AND 5.—METHOD OF SUPPORTING ARC LAMPS FROM ROOF.

A Swiss Single-Phase Railroad—Seebach-Wettingen Line.

By Frank Koester.

EVER since 1904 the Oerlikon Company has experimented with a converter locomotive running at 5000 volts, 50 cycles, with 15,000 volts on the line. The experiments soon showed that 50 cycles caused trouble to telephone and telegraph lines which run parallel to the track, and it was found that by changing the frequency from 50 to 15 the trouble disappeared, though even 30 cycles produced little or no ill effect. The voltage remained unchanged. This experimental line, which was only a small portion of the line now in operation, extended between Oerlikon and Seebach, and later on to Affoltern.

The first section, one mile long, from Oerlikon to Seebach, is not on the main line. With the additional electrification of the road, the Oerlikon system was extended to Regensdorf, the stretch from Seebach to Regensdorf being about four miles The remainder of the line, up to Wettingen, a distance of about eight miles, is equipped with the Siemens-Schuckert system.

There are three locomotives, two by the Oerlikon Company and one by Siemens-Schuckert. These locomotives are equipped with the collecting devices of both systems, so that they can run the whole leng.h of the railroad, a distance of 12 miles.

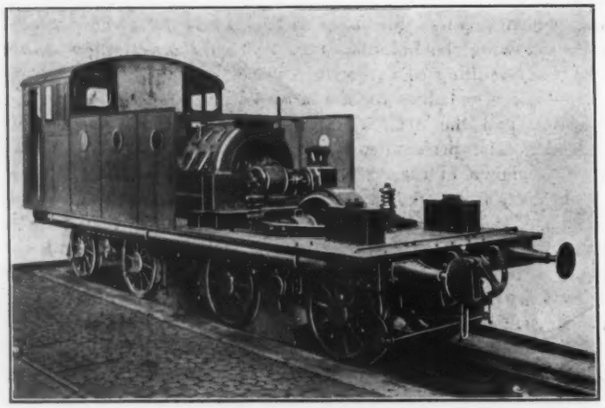


FIG. 1.—CONVERTER LOCOMOTIVE NO. 1.

The power is supplied by a 700-kw Oerlikon three-stage steam turbine, connected to a revolving field generator of 230 volts, 50 cycles. This voltage and frequency were adopted because the remainder of the plant, which supplies power for manufacturing purposes for the above-mentioned concern, is equipped with generators of this type, and in case of necessity the generators operated for manufacturing purposes can be thrown on the line. In addition to this steam power plant, power at 30,000 volts may be drawn from a water-power plant in Hochfelden.

To convert the above voltage and change the frequency for use on the trolley line (15,000 volts, 15 cycles), a separate substation was erected near the power house. It contains two motor-generator sets of 700-kw and 500-kw capacity. Each set consists of 230-volt, 50-cycle, 14-pole synchronous motor coupled on one side to a 700-volt, 15-cycle, 4-pole generator, both having excitation at 100 volts. On the other end of the shaft is coupled a direct-current generator giving 750 to 850 volts. Floating on the busbars of the generator is a storage battery located in a separate building, consisting of 375 cells with a capacity of 592 amp-hours. In connection with the storage battery, there is a 120-hp booster, which is driven by a three-phase induction motor from the power house mains. The booster has two commutators which are switched in series while feeding the storage battery and run parallel when helping out on the line. The booster is regulated either by a Thury regulator receiving current from the trolley, or by a Siemens-Schuckert 38-volt, 30-amp converter, with differential excitation. This converter is chain driven from the shaft of the larger generator set. The 700 volts from the motor-generators are stepped up to 15,000 volts for the trolley by means of four 250-kw, single-phase transformers.

The 30,000-volt, three-phase current from Hochfelden is stepped down to 210 volts for the buses of the motor-generator sets by means of a three-phase transformer.

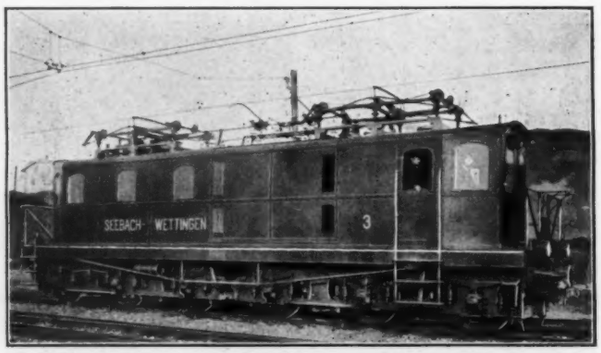


FIG. 2.—LOCOMOTIVE NO. 3.

As previously stated, the Oerlikon system runs from Seebach to Regensdorf. Most of the trolley line is mounted on a semi-rigid construction of cast-iron caps fastened to insulators mounted on poles, or carried on brackets. At the station at Seebach the trolley is carried by a catenary construction varying in spans from 165 ft. to 260 ft. For this purpose structural steel towers have been erected similar to a semaphore bridge. The trolley is hung at this point about 16.5 ft. above the rail. In order to cut out sections, switches of the horn type have been installed which are operated from the stations. Some of the switch poles carry a semaphore.

With the Oerlikon collector system current may be drawn from bottom, side or top of the trolley wire, depending upon the arrangement of the wire. The collector consists of two seamless-drawn slightly bent steel tubes about 7.5 ft. long. They are held by a four-bar linkage which is mounted on one side of the locomotive. The collector arms are held in contact with the trolley by means of springs. Contact may be secured when the trolley line is directly overhead or 8 ft. to one side of the center line. The collecting device may be raised or lowered by hand or electro-pneumatic control.

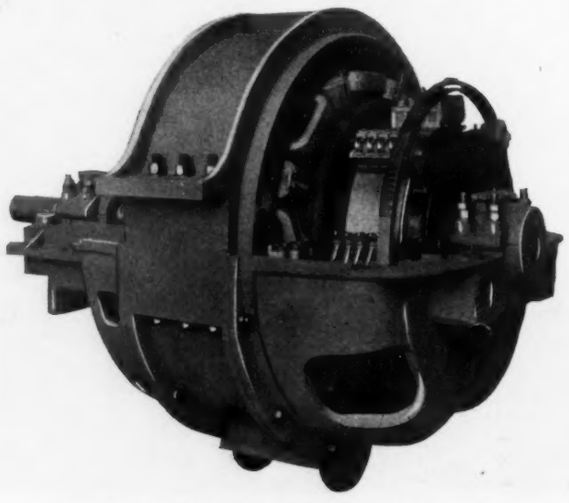


FIG. 3.—250-HP SERIES MOTOR OF LOCOMOTIVE.

The Oerlikon trolley system overlaps the Siemens-Schuckert system at Regensdorf for a distance of about 1300 ft., so that the change may be made without interruption. This trolley is held by Siemens-Schuckert catenary suspension with spans varying from 160 to 170 ft. and for experimental purposes in some cases they are placed 330 ft. apart. The catenary carries

an auxiliary catenary by vertical wires 19.7 ft. apart. The trolley is hung from the auxiliary wire by clamps 9 to 10 ft. apart. On the main line the catenary is hung from brackets carried on poles, while at stations they are hung from a pair of channels supported by two wooden poles. In some cases such a single structure overspans seven tracks.

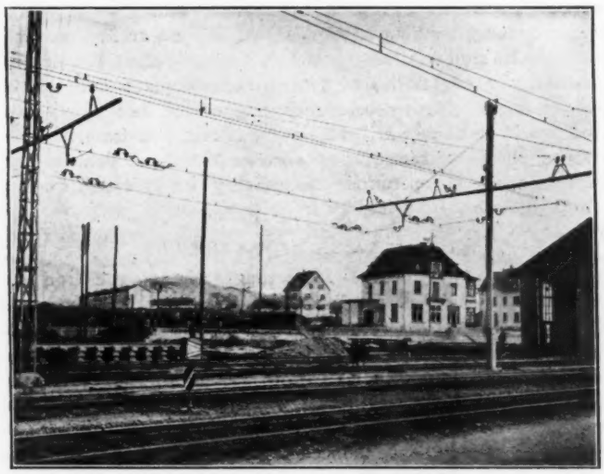


FIG. 4.—DOUBLE OVERHEAD CIRCUIT BREAKER.

The whole Siemens-Schuckert overhead construction, both trolley and catenary, is divided into sections about one mile long to take up expansion and to keep the overhead system taut. For this purpose a give-and-take arrangement is installed at the end of each section. The construction is such that there is a continuous pull of 1600 lb. on the lines. The catenaries in such cases overlap some 375 ft. and the ends lead to side poles. Where the trolleys overlap they run parallel, about 5 in. apart, for a distance of 45 ft.

Overhead circuit breakers are placed at sidings and locomotive barns, and the power may be supplied to the siding by a messenger wire. The rails are well bonded because they act

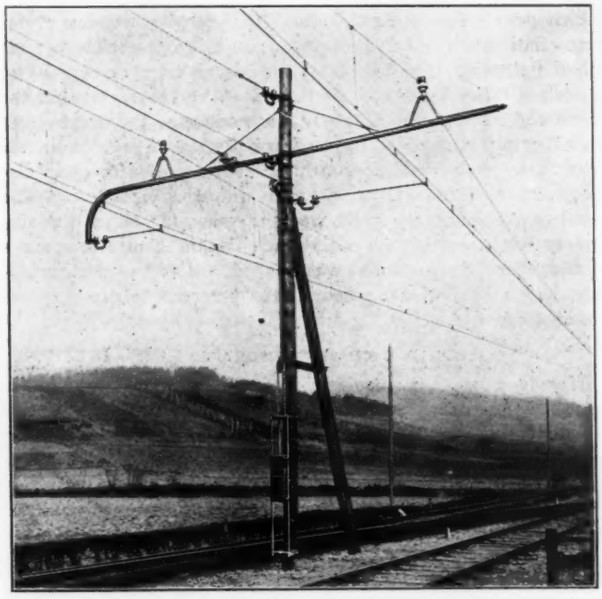


FIG. 5.—GIVE-AND-TAKE ARRANGEMENT.

as a return circuit, and at every 1.25 miles they are specially grounded by large copper plates.

Along the road are seven stations. Each stationmaster controls the section switches in his division. At the request of the Public Service Commission, an electro-pneumatic grade crossing gate was installed, and is operated in connection with the current supply from the trolley, so that when the trolley is alive the gate is closed.

The locomotives are classified as Nos. 1, 2 and 3. No. 1 was put into operation in 1904 as an experimental locomotive and was known as a converter locomotive. The alternating-current side of the converter was rated as a 650-hp, 700-volt synchronous motor, and on the direct-current side as a 400-kw, 600-volt generator, the speed being 1000 r.p.m.

The various voltages used on the driving motors, which were shunt-wound, were obtained by having a booster in circuit with the direct-current side of the converter. This booster acted either as a booster or bucker, according to the voltage desired. By means of two transformers mounted on the car, the line voltage was stepped down from 15,000 to 700.

In the reconstruction of the car, the original body was retained. Each of the two four-wheel trucks has a 200-hp motor mounted between the axles. As the motors are geared to an independent driving shaft, the drivers are operated by means of a crank pin and connecting rod. Owing to the different equipment, the weight of the locomotive was reduced from 48 to 40 tons. This locomotive has only one cab, and is provided like locomotive No. 2 with one Oerlikon collecting device and one Siemens-Schuckert pantograph.

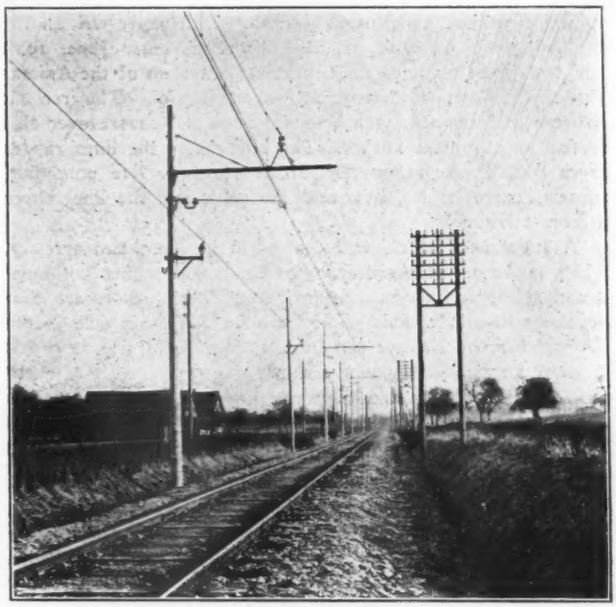


FIG. 6.—PARALLEL ARRANGEMENT OF SIEMENS-SCHUCKERT TROLLEYS.

Locomotive No. 2 weighs 42 tons and has two cabs; the remaining equipment is the same as locomotive No. 1. The current is drawn through two groups of series-parallel connected transformers. Each group consists of two 250-kw, 15,000/700-volt air-cooled transformers. There are two controllers in each cab, one for the motors and one for controlling the transformer tops.

Each motor has a capacity of 250 hp and makes 650 r.p.m. under normal conditions, and 1000 r.p.m. as a maximum. They are series-wound and are of the interpole type. As they are geared to 39.5-in. drivers by a ratio of 1:3.08, they develop a speed of about 35 miles per hour. On a grade of 8 to 10 per cent, 24 miles per hour are obtained. These figures are given on the assumption that the train is hauling a load of 250 tons. It might be of interest to state that tests have shown that the motors will operate with the same satisfaction on 25 cycles.

The compressor for supplying the air which operates the various apparatus is driven by a 6-hp motor, and supplies air at pressures varying between 75 lb. and 105 lb. per square inch. The current for the motor, as well as for lighting and heating, is drawn from special taps on the transformer.

Locomotive No. 3 is provided with two 6-wheel trucks, and as it was built by the Siemens-Schuckert Werke, Berlin, it is

of the same design as those used on the Marienfelde-Zossen locomotive. Although this locomotive is designed to have six motors, only four are mounted, two for each truck. They are geared to the drivers in a ratio of 1:3.72. They have a capacity of 225 hp, have 8 poles and are artificially cooled. These trucks have king pins, while the other locomotives have swiveling points, controlled by levers. The transformer equipment of this locomotive consists of two 500-kw oil-cooled transformers wound for 15,000/288 + 330 + 378-volt transformation. Provision is made in the high-tension compartment for the accommodation of three contactors for speed control and two for controlling direction of current.

A 4-motor locomotive weighs 68 tons, one with six motors, 75 tons. In the latter case the tractive effort is 15,600 lb., while the maximum is 25,740 lb. In the former case the tractive effort is 10,300 lb., with a maximum of 17,200 lb.

Lightning Phenomena.

By E. E. F. Creighton.

IT is the object of this paper to give a general review of several of the more important results of the study of lightning phenomena and electrical surges obtained by the writer during the past year. These studies involved the construction of special apparatus which were described in a paper written for the American Institute of Electrical Engineers, June, 1908. The tests were made on the transmission system of the Animas Power & Water Company, at Silverton, Col. The records indicate that the storms are as frequent and severe over this system as any place known. The altitude of the lines ranges from 8000 ft. to 13,000 ft. There are four line potentials, namely, 43,500, 17,000, 2300 and 440 volts, and the lines cover a large territory.

A subsequent article will deal with the aluminum arrester, which is the only known means of protection against continual electrical surges on transmission lines. These articles are condensations and revisions of lectures and of an article in the *General Electric Review* for June, 1908.

A third article will give a résumé of measurements of earth contact resistances and cement resistors and recommendations for the protection of buildings.

LIGHTNING PHENOMENA.

The five principal factors studied in the Colorado tests were: Duration of surge of lightning, potential values of the lightning, maximum current discharge rate, natural frequency of the lightning, and quantity of electricity in the lightning stroke.

THE DURATION OF LIGHTNING.

The duration of lightning on the transmission line was measured by means of a spark-gap in front of a rapidly revolving photographic film. Out of three dozen discharges, the usual duration of a single stroke was in the neighborhood of one one-thousandth of a second. The longest single stroke of induced cloud lightning recorded was 0.04 second. The actual duration of the usual stroke of cloud lightning is known from many observations to be comparatively short. A fairly authentic record of one stroke of the order of a half second has been made. Such a length of duration, however, is rare, and careful measurements seem to indicate that such a duration is only the effect of multiple strokes, or successive discharges from the clouds.

In certain classes of storms the successive strokes take place slowly enough to be observed visually. They seem to be due to the readjustment of potential between clouds. For example, a cloud discharges and releases the potential strain in its neighborhood. The static electricity which, up to this time, had been distributed over the face of the adjacent cloud next to the earth or other oppositely charged clouds, is now drawn through the high internal resistance of this cloud toward the one which has just discharged and has been reduced to earth potential. It seems that this readjustment in the non-discharged cloulds requires an appreciable time. Finally the static strains between this cloud and the one discharged is sufficient to cause a cloud-to-cloud discharge, which readjusts temporarily the potential in this locality but causes another stroke to earth. This process is repeated indefinitely until all the clouds in the neighborhood have readjusted their potentials with the original discharging cloud.

There is another consideration of duration of lightning which comes under the head of continual surges. Continual surges usually occur from an internal source. The usual cause is the grounding of a phase through an arc. The duration of this kind of discharge depends entirely upon the circumstances. So long as the arc to ground takes place there will be surges more or less severe according to the local conditions, which will continue until the trouble is removed from the line. During the measurements last summer aluminum lightning arresters were in operation continuously for periods ranging from 40 seconds to a half hour.

POTENTIAL VALUES OF THE LIGHTNING.

The maximum potential value that a lightning charge can have on the line will result from a direct stroke. The usual effects of a *heavy* direct stroke are well known—the lightning jumps over the insulators and down the poles to the earth. If the stroke is not heavy enough to jump over the insulators to the earth, then it will spread over the line and the lighning arrester has an opportunity to carry the discharge to earth. These induced potentials may have all values ranging from the spark voltage from line to ground down to insignificant values. The observations of last summer show conclusively that the potential on the line nearest the clouds is the peak value, and when the charge is freed it spreads gradually over the line, giving at every other point a lower potential. If there were no resistance in the path of the complimentary charge on the surface of the earth, this high peak of potential would travel undiminished in a wave along the line to the end. If the storm occurs at the station the lightning arrester in the station must take care of this excessive peak potential. The difference in the requirements to discharge under these two conditions of nearness or distance of the lightning storm really comes under the consideration of the maximum current discharge rate.

In connection with the subject of the arcing at the insulators, a digression in this discussion is made to describe some tests which gave concrete figures on the value of a wooden cross-arm relative to a metal cross-arm as an extra protection against cloud lightning. On a wooden cross-arm were arranged two porcelain tubes holding wires 1.7 in. above the surface of the wood and 10 in. apart. On the upper surface of the wood either tinfoil or a wet towel was placed in imitation of line conditions. The first test on this cross-arm was made on a 60-cycle circuit with a needle-gap in parallel with the cross-arm. The spark e.m.f. of 47,000 volts was the same for either the tinfoil or wet towel on the cross-arm. On the contrary, when a sudden disruptive potential was applied, the wet wooden cross-arm had a break-down potential 160 per cent as great as the metal cross-arm.

MAXIMUM CURRENT DISCHARGE RATE.

If only generator frequency is considered the rate of discharge is controlled principally by the resistance in series, but when frequencies of lightning, of thousandths of cycles per second, are considered, the line inductance plays an important part in limiting the discharge rate of lightning. In the discharge of a lightning arrester the maximum possible current will occur when the resistance is zero. This current may be expressed by the simple formula $I_m = V \sqrt{\frac{C}{L}}$ where C is either the capacity per unit length of the line, or the total capacity of a condenser, and L is correspondingly the inductance of a unit length of line, or the concentrated inductance in a coil. In the high-frequency circuit in the laboratory the maximum current is 0.03 amp per volt impressed; consequently, at the value of 100,000 volts impressed, the maximum possible rate of discharge is 3000 amp. The value of current is actually somewhat less than this on account of the resistance of the circuit

and the spark. On transmission lines the maximum possible current of a discharge coming from a distance out on the line is of the order of 0.002 amp per volt impressed. Therefore, in order to produce a current of 10 amp the impressed potential of lightning would have to be 5000 volts—10 amp is the current limitation at double normal voltage of some of the old types of arresters. In order to get a current discharge of 1000 amp, the applied potential must be at least 500,000 volts. This is the value of current discharge of the aluminum arrester at double normal voltage.

If, however, the lightning cloud is above the station or arrester, then the maximum possible rate of discharge may be somewhat greater than the value given above, on account of the fact that the average inductance of the line wire in the path of the discharge is less than in the previous case considered. Furthermore, it has already been noted in the paragraph on potentials that the maximum potential of the lightning is invariably greatest under the discharging cloud; consequently the rate of discharge of the arrester must be greater on account of the higher induced potential.

THE NATURAL FREQUENCY OF LIGHTNING.

The frequency of lightning may be considered under four heads:

(1.) The frequency of occurrence of the lightning stroke. For example, lightning strokes often come into a station during a storm at an average rate ranging from two per minute to one in five minutes.

(2.) Each of the flashes that appear to the eye as a single flash is often several distinct strokes distributed over a fraction of a second.

(3.) Each individual stroke may be analyzed into frequencies of the order of the natural frequency of the line. This was done in the Colorado tests by means of a rapidly revolving film in front of a spark-gap. The records show the frequency distinctively by the broken line; each part of the broken line corresponds to a half-cycle of the spark between the transmission wire and ground. There was no generator connected at the time of the test.

The accuracy of measurement is not high, so that the frequencies recorded are divided into seven groups. One stroke at 840 cycles per second, eight strokes at about 1400, six strokes at about 2000, two strokes at about 2500, 20 strokes at about 3000, and one stroke at about 4000.

(4) There is possible also a still higher frequency than the one just described. This frequency corresponds either to the line oscillating in segments or to a high frequency induced on the line by the natural high frequency of the cloud lightning.

In order to prove that this high frequency exists on the line, a special form of high-frequency meter was designed, working on the principle of interference of traveling waves, or, in other words, stationary waves. This instrument had a number of coils resembling the pipes of a church organ, each one responding to its individual frequency and over-tones. Due to the initial experimental difficulties with this apparatus and the natural condition of discharge on a long line, only two of the many records taken were of value. Both of these records show frequencies of the order of a million cycles per second.

QUANTITY OF ELECTRICITY IN THE LIGHTNING STROKE.

By means of fuses and the duration meter, the quantity of electricity to blow a fuse can be found. Its value $Q = \sqrt{\frac{Jt}{R}}$, where J is equal to the energy in joules necessary to raise 1 cm length of fuse metal to its melting point, t is the duration of discharge and R is the resistance in ohms per centimeter length of fuse metal. The joules of energy necessary to melt the fuse can be found by calculation of the metal used, or by actual calibration by the use of an oscillograph. The average effective quantity of lightning (q) passing through a fuse is equal to Q divided by the number of oscillations shown by the revolving film. If the oscillations are few in number, this calculated value is approximately equal to the original quantity on the line freed by the cloud discharge.

RECLASSIFICATION.

Summarizing some of the essential parts of the foregoing discussion we have: that the strain on the lightning arrester will depend on the size of the storm cloud, the nearness of the cloud to the line, the distance of the storm away from the arrester, the resistance of the surface of the earth, the condition of the multiple stroke and the time elapsing between them, and the condition of continual surges. The effects of these factors may all be grouped under three heads:

(1.) The spark potential of the arrester. The arrester must be capable of sparking over at a voltage which is within the safe value of the insulation.

(2.) The factors which relate to the rate of discharge of the arrester. After the spark is established, the arrester must have a resistance low enough to discharge the maximum rate of current that could flow to that point.

(3.) The factors which relate to the duration of the discharge of the arrester. It should have a duration sufficient to discharge so long as the potential is dangerously high. This factor is of paramount importance.

For many years the presence of continual surges on a transmission line was not fully understood. Lightning arresters were designed *par force* for transitory lightning. The multigap arrester is distinctly a transitory lightning arrester. It cannot be expected to carry the discharges which occur on a system from continual surges. With the graded shunt resistance on the multigap arrester, light discharges may be taken through the high resistance for an appreciable time, but through the low resistance the amount of energy dissipated is large, and consequently the duration of the discharge must be correspondingly small.

Occasionally, through a broken insulator, a transformer bushing, or a switch bushing, one wire of a non-grounded-neutral system will become grounded through an arc. The arcing ground will send a series of surges throughout the entire system. It is necessary to have a lightning arrester on the circuit which will discharge the abnormal voltage for a time long enough to permit the operator to locate and isolate the trouble.

The aluminum arrester is the only one having inherently the qualities which permit a design to carry discharges continuously for any length of time desired, without appreciable loss of energy and still allow a heavy discharge of lightning.

A description of the aluminum arrester, together with a discussion of its characteristics, will be given in a subsequent article.

Electric Motor Printing Press Drive.

By S. H. SHARPSTEEN.

A SPEED variation of 20 to 1 is required in web-printing press work. In cases where the driving or main shaft of the press runs about 200 r.p.m. for maximum production, this same shaft should have a speed of 10 revolutions or less per minute for plating and threading, or, as it is called in the press room, making ready.

To the inexperienced in press drive it seems an easy matter to get this speed variation by inserting resistance in circuit with the armature and reducing this resistance until the armature comes to the desired speed.

When high efficiency is not required or the consumption of electricity is not of much importance, this method of changing speed answers very well for fan work. The fan starts easily and runs along smoothly, gradually increasing in speed as the controller lever cuts out the resistance until the maximum speed is reached. The same is not true of a web printing press. With a fan there is usually but one shaft, a few blades and two bearings. The Hoe or Goss web press, with an average production of impressions, has hundreds of bearings, gears and pinions and tons of moving weight, with much pressure between the impression and plate cylinders to produce friction. When the grease on the gears and pinions and the oil in the bearings are hardened by a low temperature, as sometimes occurs, these presses start very hard.

In Fig. 1 consider that *A* is the armature of a 30-hp electric motor geared to a Hoe quadruple press, and that *C B* is the controller box for the same equipment. On closing the service switch *S* and moving the lever *L* over to the left until it reaches point 3 on the dial of the controller, current will pass through the service wire *C* to the lever *L*, thence through the resistance *R*, the brush *B'*, armature *A*, brush *B*, and into the other leg of the circuit *C'*, causing the armature to move the press ahead. It was necessary to place the lever on point 3 to make the press start. When the press is once in motion, the lever could be placed back on point 1 and the press still run slowly if the resistance is properly designed and adjusted.

If this was a disk fan equipment with a 5-hp motor and controller, the fan would have started when the controller handle touched point 1.

When web presses are equipped with this system of control the pressmen complain of the presses jumping, as they say, at starting and breaking the paper, or, if threading in the paper, they are fearful of getting their fingers caught between the rollers as the press gives this sudden movement ahead.

The conditions in web-press drive are favorable for excessive standing friction. To make the press start the pressman must cut out a number of blocks of resistance, causing often one and one-half times the full-load current to pass through the armature. When once moving, the friction is reduced to such an extent that if the torque or turning effort is not reduced instantly, the press speed builds up very rapidly.

In actual practice there is a small amount of space between the teeth of the gears that lets the motor get some speed before very much work is required.

If it takes 230 volts and 100 amp to drive the press at full production speed, the same amount of energy will usually be used by the equipment when threading in paper at a constant slow speed with this control. In other words, the amperage remains practically the same regardless of the speed of the motor and press up to the maximum speed of the equipment, if no field control is used and the line voltage remains constant, not considering the inrush that might be caused at the start by an abnormal amount of resistance *R* being cut out when the press starts very hard. As the press requires more speed and power, the difference of potential increases between the brushes *B* and *B'* and decreases between the point *H* and the lever *L*. From threading speed up to the point where the resistance *R* is cut out, this transfer of pressure or potential from resistance *R* to the brushes *B* and *B'* is caused by moving the lever *L* to the left.

If a 40- or 50-hp motor is used in this case instead of one of 30 hp, the quantity of current would not necessarily increase or decrease, the method of control remaining the same.

An experienced operator could move the press slowly with this equipment by rapidly swinging the controller handle back and forth over the first points of the controller. In fact, this is being done every day, but is not desirable since a better method can now be had.

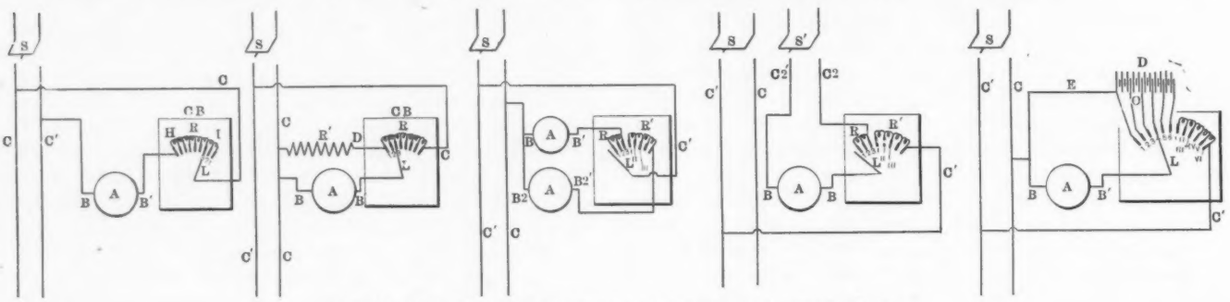
When the simple armature control is used for web-press drive, the motor should be slow in speed and compound-wound.

It is desirable especially when installing the smaller web presses to try and get a satisfactory large range of speed with only one motor, and in many cases a system of control similar to that illustrated in Fig. 2 is adopted. This is practically the same as the simple series system of Fig. 1 with the addition of a resistance *R* extending from the resistance *R* at *D* over the wire *C*. There are now two paths for current, from *C* to resistance *R* when the switch is closed and the lever *L* moved in contact with the points 1, 2 and 3 on the controller dial. In commercial work the controller is designed to open the resistance *R'* before production of speed is reached.

When ready to start the Hoe quad press for threading paper, if the switch *S* is closed and the lever *L* is moved slowly to the right until the press starts, and if conditions are normal and the system is properly designed and installed, the press should run at a steady slow speed for the threading. As in Fig. 1, the motor armature *A* commences to increase rapidly in turns when once started, but as the counter e.m.f. of the armature increases the resistance *R'* takes a part of the current. The higher the counter e.m.f. the more current this armature shunt resistance takes until just enough passes through the armature to do the work of moving the press slowly.

After starting, if the paper tension should be increased and more power demanded, instead of the motor making a big sag in speed as would be apt to occur with simple armature control, the armature *A* slows down a small amount, the counter e.m.f. is reduced at *B* and *B'*, and hence a little current is taken from the resistance *R'* to do the small additional work. This arrangement decreases the efficiency over simple series armature resistance, but since the time devoted to starting and threading is small, the gross consumption is not materially increased.

The system almost universally installed for large web printing press work is what is known as the two-motor drive. A small motor is used to operate the press for threading and plating and a large motor for production drive.



FIGS. 1, 2, 3, 4 AND 5.—ELECTRIC MOTOR PRINTING PRESS DRIVE.

In some large installations the small motor is placed on top of and drives through the shaft of the large motor. This plan saves floor space where the drive is placed on the same floor as the presses, but makes repairs on the large motor somewhat more difficult. The motor shafts are parallel and the two machines are geared so that the small motor comes to maximum speed when the large one has only about one-twentieth speed. The small motor can be placed on an iron base with, and drive through the shaft of, the large one by means of worm gear In this case the shafts of the motor will be at right angles to each other.

There are installations where each motor drives the press independent of the other. This is preferable, as it allows the press to be operated slowly by the small motor for repairs or emergency when the large motor is out of commission and its armature removed for repairs. Fig. 3 illustrates this kind of drive.

Assume that *A* is the armature of a small motor mounted upon and geared to the shaft of a large motor, its armature being designated by *A'*. When it is desired to start the press, the service switch *S* is closed and the lever *L* moved slowly to the right until it touches the point 1 in the resistance *R*. Current then passes from *C*, through the brush *B*, armature *A*, brush *B'*, the resistance *R*, and thence through the lever *L* to the other leg of the circuit, *C'*; when the lever has passed to point 3 the resistance will be cut out of circuit with the armature *A* and the small motor brought up to full speed under normal conditions. As this motor is geared back so that it only drives the press at one-twentieth its normal speed, it might

seem that it should be only one-twentieth the horse-power capacity of the large motor, but since it is so hard to start some makes of web presses, the small motor should be at least one-tenth the maximum horse-power capacity required to drive the press for production. In many cases much larger motors are installed for this purpose.

When the paper is threaded and the press is ready for production speed, the lever L is pushed to the blocks or points I, II, III connected with the resistance R', when the current is cut off from the small armature and passes through the armature A': the large motor then furnishes power to move the press and the small motor comes to rest, its connection with the drive being released by a ratchet.

The two-motor drive for web printing presses allows the use of two- or three-phase alternating current motors for this work.

Throughout the country there are many newspaper printing establishments that have one or two web presses where direct current cannot be obtained for power purposes and the consumption of current is too small for an isolated plant. Where belt drive is being used and there is a mechanical device for getting the slow speed, it is an easy matter to dispense with the old method of drive and install one large alternating-current motor to drive the countershaft from which the press is operated.

Where a new newspaper plant is being installed and may be large enough some day to warrant an isolated generating set, or where it is desirable to change to electric drive and control because of the ease with which safety devices can be used or for any other reasons, two alternating-current motors can be used, one for the slow-speed and another for the high or producing speed, similarly to the way two direct-current machines are now operated for the same purpose. The method of control will not be so flexible as when direct-current apparatus is used, but where one low speed is wanted for making ready and one high speed for production, the alternating current will answer.

One large motor for operating a web press for both making ready and production and obtaining the low speed by using current of low voltage to give the low speed with the large motor, is the ideal way and has not been given the attention that it seems to warrant. The web newspaper presses in the New York *Sun* printing room are operated in this manner, and the low-voltage current is supplied by a small rotary converter or machine used to transform current from 240-volt street mains down to a low voltage for operating the large machine at low speed. In this case each equipment or press has a small motor-generator set of its own which is called the teaser.

In Fig. 4, consider that when the service switch S is closed, the points 1, 2 and 3 on the dial of the controller and the armature A can get current from the teaser or small motor-generator, and by closing the service switch S, line current can be obtained for the points marked I, II, III, etc. Proceed by closing the switches S and S' and moving the level L slowly to the right over the points; when 3 is reached the full voltage of the teaser will be used and the armature A will be running for make-ready. When a higher speed is wanted, the lever L is passed to the points I, II, etc., when the current will be cut off from the teaser and the armature A operated from the service wires, C and C', for production.

The National Folding Box & Paper Company, of New Haven, Conn., has a number of calendering presses operated this way, the low-voltage current being furnished by one rotary. When the presses were started it was discovered that the rotary was too small to furnish current for slow speed when more than one press was started at a time. Possibly the designer did not understand that almost as much energy must be furnished to run a press at low as at high speed when the armature or series control is used.

For newspaper work it would be disastrous to have every press shut down at rush hours, and this method would hardly answer as the operation of the whole press equipment would depend on the one rotary.

The ideal method for a large newspaper plant is to have a storage-battery plant for the slow speeds. With this plant a very low constant steady speed can be had when required for turning the press over for repairs, and if one press crew could thread faster than another, the threading speed could be furnished as demanded. The different series of battery could be connected in parallel, and in case of injury to a single cell or a series of cells, the system would not be crippled very much.

Fig. 5 shows a simple example of this method. When the starting lever L is pushed to the right, consider that current passes from the storage battery D, through E to the brush B, armature A, brush B', lever L to point 3 on the dial controller face and back to the battery D, through wire O; on this third step there will be 10 volts at the brushes B and B', as five cells of battery are in circuit and each cell corresponds to 2 volts.

If a higher or lower speed should be required, the lever could be placed on the points as the case might demand, and the speed obtained would not depend on resistance in circuit with the armature, but would be produced by a fixed voltage at the brushes, giving almost absolutely the same speed every time used regardless of the load varying to a limited degree. This is important in web press drive and would be very much appreciated by the pressmen.

When the lever L passes the point 6 on the dial of the controller, the battery circuit will be opened and the points I to VI will give producing speeds by taking current from the wires C and C', as in the former cases.

The methods of supplying the armatures under consideration with current have been used in a simple way for the purpose of helping the reader to understand the different kinds of electric-motor web press drive.

Special Steels for Electrical Purposes.

A new electrometallurgical industry has been created in recent years as a result of the possibility of making low-carbon ferro-alloys, free from undesirable impurities, in large quantities and at a reasonable cost in the electric furnace. In close connection with this development have been rapid advances in the manufacture of special steels, having certain desirable mechanical and chemical properties for special purposes (armor-

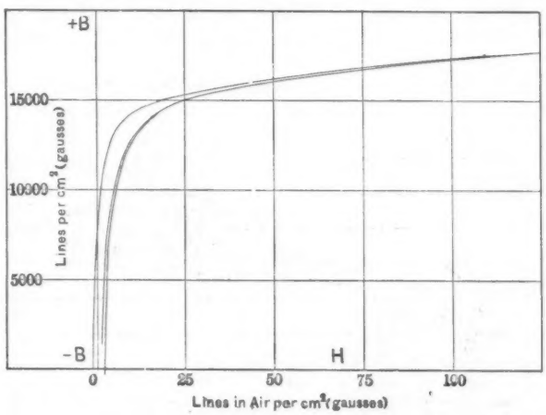


FIG. I.—MAGNETIZATION CURVES OF KRUPP STEEL. (REICHSANSTALT TEST.)

plates, high-speed tools, automobiles, etc.). The chief elements alloyed with iron are silicon, manganese, tungsten, chromium and nickel, while vanadium, titanium and molybdenum also attract much attention now.

A special field of the special-steel industry is the manufacture of steel for electrical machinery, such as transformer and armature sheets. Though much work has been done in this field, most of the results have not been divulged. Many of the electrical manufacturers have the steel which they use made according to their own specifications, which they keep secret. On the other hand, there are now several steel companies who make a specialty of steel for electric purposes and sell it to the electrical trade in general. It may be interesting to collect here such data as are available.

The chief desiderata of steel for electrical machinery are high permeability, a low and constant hysteretic constant, and high electric resistivity in order to reduce the eddy-current loss.

Figs. 1, 2 and 3 give B-H curves of various electric steels. Fig. 1 gives the results of tests made in the German Reichsanstalt on dynamo steel, made by Fried. Krupp in Essen. The same steel was also tested by Professor Ewing with quite similar results. The latter states that this steel "is scarcely distinguishable in its magnetic qualities from the best wrought iron. Its permeability under low magnetizing force is remarkably high; in this respect it excels not only any castings, but also any forgings for dynamo magnets which I have hitherto met with."

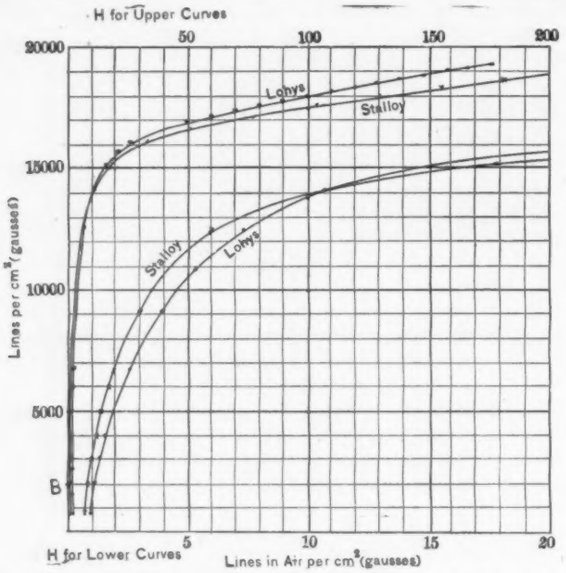


FIG. 2.—MAGNETIZATION CURVES OF STALLOY AND LOHYS STEELS.

Fig. 2 gives B-H curves of two steels, known under the trade names "Stalloy" and "Lohys" and made by Joseph Sankey & Sons, Ltd., in Bilston, England, under the Hadfield patents. The lower curves in Fig. 2 are enlargements of the lower parts of the upper curves.

Fig. 3 gives the results of tests made in the Case School of Applied Science of a new electric steel, made by the West Steel & Iron Casting Company, of Cleveland.

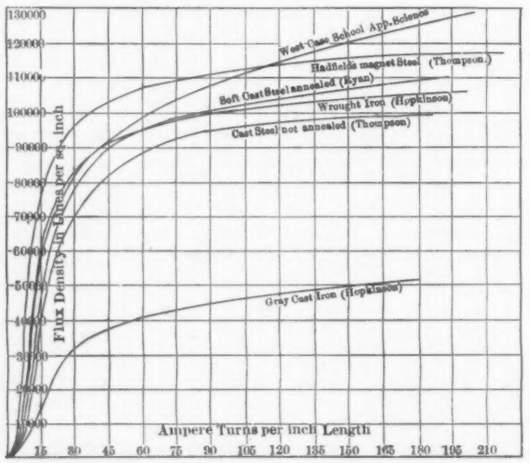


FIG. 3.—MAGNETIZATION CURVES OF WEST STEEL AND OTHER MAGNETIC STEELS. (CASE SCHOOL TEST.)

As to hysteresis loss, the Reichsanstalt report on the Krupp steel gives the following comparative figures on the hysteresis loss per cycle in various materials:

Swedish charcoal iron	8,400	ergs	per	cubic	centimeter.
Krupp dynamo steel	11,100	"	"	"	"
Soft steel	14,700	"	"	"	"
Wrought iron	20,700	"	"	"	"

These figures are found by plotting the hysteresis loop from Fig. 1 and measuring the area.

The total iron losses, including hysteresis and eddy-current losses, have been determined for the materials "Stalloy" and "Lohys" in the testing laboratory of the manufacturers. Fig. 4 gives the energy loss in watts per pound in 0.02 in. "Stalloy" at 40, 50, 60 and 100 periods per second, and for various magnetic inductions. It is claimed that the eddy current loss is so small that there is no advantage in using sheets thinner than 0.02 in.

As to the constancy of the hysteresis loss, no exact figures are available, but it is expressly claimed by the makers that "Lohys" and "Stalloy" have "non-ageing properties."

It is interesting to note the progress which has been made in electric steel as indicated by the diagrams Figs. 1 to 4. When the firm of Krupp began their experimental work, the intention was to produce a steel which would equal pure Swedish charcoal iron. Later developments have shown that a step farther can be taken and a steel produced which is superior in its magnetic properties to pure iron.

The chief element which is effective in improving the magnetic quality of iron is silicon. As far as analyses are available, electric steels are low-carbon silicon steels. Thus a steel for transformer sheets of German origin has the following analysis according to G. Kapp (R. Pohl, ELECTRICAL WORLD, July 13, 1907, p. 96): 96.2 iron; 3.4 silicon; 0.32 manganese; 0.03 carbon; 0.04 sulphur; 0.01 phosphorus.

The pre-eminent importance of silicon is also evident from the long list of patents which have been granted to Mr. R. A. Hadfield for magnetic steels. It is interesting to quote here the first claim of his first patent (745,829, Dec. 1, 1903): "A magnetic material containing a magnetic body with an admixture of silicon in such proportions as to increase the magnetic permeability and electric resistance and to decrease the hysteresis quality of the material to figures above and below respectively those which obtain with the purest iron commercially obtainable."

Later patents of Hadfield relate to iron-silicon-aluminum and iron-silicon-manganese alloys, but silicon is always the chief alloying element.

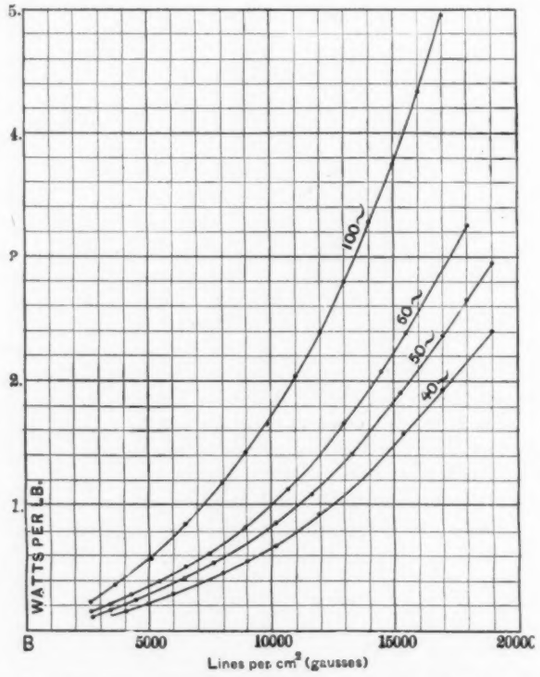


FIG. 4.—HYSTERESIS AND EDDY-CURRENT LOSSES IN STALLOY STEEL.

Finally, it may not be amiss to emphasize again that the constitution of the steels noticed above requires for its manufacture very pure low-carbon ferro-alloys, such as can be made only in the electric furnace. As the electrolytic copper refinery supplies to the electrical industry the pure copper needed, so the electric furnace supplies the ferro-alloys needed in the manufacture of steel for electrical purposes.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Liability of Electric Companies for Accidents.

Mr. T. A. Lloyd, superintendent of the electrical department of the Shreveport (La.) Gas, Electric Light & Power Company, writes as follows with reference to an article by John E. Brady, Esq., on page 22 of the issue dated July 4, 1908, entitled "Liabilities of Electric Companies for Accidents Due to Fallen and Broken Wires":

"My understanding of the general rule of the courts as to the liabilities of electric companies for accidents due to fallen and broken wires is as follows:

"Where an electric-light wire falls from its proper place and injures a person passing in the street, negligence is not to be presumed from the mere fact of the falling. A wire may have some defect which the most astute care cannot discern. A wire originally good may come to be defective and break when no human skill could detect the defect. Culpable blame must be established.

"In my opinion, however, an interpretation of the law so favorable to the electric company could not be obtained in many States. I believe that in the absence of other evidence many juries would find the light company guilty of negligence by reason of the mere falling of the wire and the consequent injury.

"To guard against this charge of negligence, the light company should periodically inspect all high-voltage lines and poles carrying them and remedy any defects existing. The inspector should then report by letter stating that the poles and lines are in good, safe condition.

"Letters showing inspection from time to time would then be on file and would effectively negative the charge of negligence and thereby free the light company from liability in this class of cases."

High Efficiency Lamps at Montreal.

High efficiency lamps have not as yet made much impression upon the central station situation at Montreal, according to Mr. J. J. Cagney, chief agent of the Montreal Light, Heat & Power Company. Some of the supply houses are taking on agencies for the more efficient lamps, and a few new installations have been made, but so far the company has not mapped out any plan of renewals, and until the situation materially alters, will not do so. Mr. Cagney is proceeding on the plan of letting the new lamps take care of themselves, at least until there is some popular demand for action on the part of the supply company. It is from this point of view a short-sighted policy to inaugurate a system of renewals on short notice for high efficiency lamps on account of the effect upon the revenue. A better policy, Mr. Cagney considers, is to endeavor to make the adoption so gradual that the ratio of increase of new business would offset the ratio of decrease in existing business because of the employment of the new lamps.

An Attractive Lamp Exhibit in Boston.

The Edison Electric Illuminating Company, of Boston, has placed on exhibition in its Boylston Street show rooms one of the most attractive and helpful lamp displays ever made in that city, with particular reference to the comparison of the newer types of high-efficiency lamps with the old carbon incandescents. The exhibit is mounted on a double frame in front of the company's largest show window, and is wired with switches so that the quality of light from any one of the samples displayed can be readily shown.

The designations on the individual lamps are worded so clearly and with so much regard to the needs of the non-technical inquirer or customer that they are given below:

"No. 5 Gem, 100 cp. Uses 250 watts. Furnished plain, frosted, red, blue or green (dipped). Cost of electricity per hour, 3 cents. Renewed free.

"No. 3 Gem, 50 cp. Uses 125 watts. Furnished plain, frosted, red, blue or green (dipped). Cost of electricity per hour, 1 5/10 cents. Free renewals.

"No. 2 Gem, 40 cp. Uses 100 watts. Furnished * * *, etc., as above. Cost of electricty per hour, 1 2/10 cents. Free renewals.

"No. 10 Gem, 20 cp. Uses 50 watts. Cost per hour, 6/10 cent. Excess charge per lamp, 5 cents. Excess cost of lamp per hour, 1/80 cent. Total cost for use of lamp, one hour, 5/8 cent. Furnished plain or frosted. Compare this with other lamps.

"Tantalum, 20 cp. Only 40 watts. Cost of electricity per hour. 48/100 cent. Excess charge for lamp, 30 cents. Average life of lamp, 400 hours. Excess cost of lamp per hour, 75/1000 cent. Total cost for use of lamp, one hour, 6/10 cent.

"Tungsten, 32 cp. Only 40 watts. Cost of electricity per hour, 48/100 cent. Excess charge for lamp, $1. Average life of lamp, 700 hours. Excess cost of lamp per hour, 142/1000 cent. Total cost for use of lamp, one hour, 2/3 cent.

"Tungsten, 48 cp. Only 60 watts. Cost of electricity per hour, 72/100 cent. Excess charge per lamp, $1.10. Average life of lamp, 700 hours. Excess cost of lamp per hour, 157/1000 cent. Total cost for use of lamp, one hour, 877/1000 cent.

"Tungsten, 80 cp. 100 watts. Cost of electricity per hour, 72/100 cent. Excess charge per lamp, $1.10. Average life of lamp, 800 hours. Excess cost of lamp per hour, 156/1000 cent Total cost of lamp per hour, 1 1/3 cents.

"Small carbon lamp, 2 cp. Used only in sign lighting. Thirteen watts, furnished plain. Free renewals.

"Standard carbon lamp, 4 cp. Regular style used in signs and places where minimum light is wanted. Uses 20 watts. Furnished plain or frosted, with free renewals.

"Standard carbon lamp, 8 cp. Regular style used in places where small amount of light is wanted. Uses 30 watts. Furnished plain, frosted, red, blue or green (dipped), with free renewals.

"Standard carbon lamp, 16 cp. Regular style used on Edison service. Uses 50 watts. Furnished plain, frosted, red, blue or green (dipped). Cost per hour, 6/10 cent.

"Round bulb lamp, 16 cp. Useful for decorative lighting. Uses 30 watts. Furnished plain or frosted. Five cents excess charge.

"Round-bulb lamp, 16 cp. Useful for decorative lighting. Uses 50 watts. Furnished plain or frosted. Five cents excess charge.

"Tubular lamp, 8 cp. Useful for decorative and concealed lighting. Window work. Uses 30 watts. Plain or frosted. Excess charge, 10 cents.

"Tubular lamp, 16 cp. Decorative and concealed window lighting. Uses 50 watts. Plain or frosted. Excess charge, 10 cents."

Electricity at the National Association of Dentists' Convention.

A striking feature of the convention of the National Association of Dentists, held in Boston during the last week of July, was the part electrical apparatus is playing as an auxiliary to the equipment of the modern dental profession. The convention made its headquarters at the Hotel Somerset, and in the parlors and basement was held an elaborate exhibition of

the latest dental appliances. The central station man who desires to add to his non-peak load will do well to investigate the electrical equipment now available to lighten the labor of the dental operator. The exhibits at Boston depending upon electricity were indicative of remarkable recent progress in the design and manufacture of labor-saving equipment for dental service.

The International Electric Laboratories of Boston exhibited a complete line of X-ray apparatus for oral diagnosis, including induction coils, vacuum tubes for special treatment, fluoroscopes, X-ray tubes, reflectors and photographic films for use in mouth radiographs.

A recent development makes it possible for a sensitive film to be placed in the mouth without exposing it to visible light, and an X-ray picture taken of the group of teeth under consideration with an exposure of about 30 seconds. In about 1.5 minutes the film can be developed, showing to the operator and patient at once the condition prevailing, including the presence of fillings in tooth canals, the existence of malformations hidden beneath the gums, presence of broken off instruments, appearance of new roots, etc. All the outward benefits of a post-mortem examination of the mouth and jaw are available by this method, and its application has already relieved many chronic cases through the diagnosis now possible. The triumphs of the X-ray in bone surgery are being experienced afresh in the field of oral surgery.

The S. S. White Company, of Philadelphia, exhibited an electric furnace with double muffle and pyrometer attachment, and other electric heating apparatus. The muffle is built with an outer envelope inclosing the inner muffle proper, which carries the heat wires, with a fire-clay door by which to close the opening.

Both units are of a refractory composition, held together by fillings and plugs, the whole being enclosed by a thin, tight-fitting steel jacket. The heating wires pass around the inner muffle, embedded in its substance deep enough to avoid accidental short circuiting, but not deep enough to interfere with the radiation of heat into the chamber. There is thus a uniform temperature throughout the chamber, easily regulated to the porcelain used. The electrical connections are made automatically by placing the muffle in position. The White Company also displayed a 13-contact regulating rheostat for use with the furnace, the large number of contacts being designed for close regulation, particularly when working with the pyrometer attachment. The company provided a thermo-couple for pyrometric measurement inside the muffle.

The Spencer Toll Company, of Schenectady, N. Y., exhibited a dental office switchboard containing two full-voltage outlets and three low-voltage outlets. The former connected an engine motor, lathe, gold annealer, sterilizer, water heater, furnace, atomizer heater, fan and bracket lamp. The latter were arranged to control a mouth lamp, antrum lamp, root drier, hot-air syringe, and various heating joints, with provision for connection to gold-plating apparatus. This company also exhibited a hot-air electrically-warmed syringe adapted to the destruction of septic matter, drying out cavities, inlay work, bleaching operation, setting cements, etc. It also showed a cold lamp of the low-voltage incandescent type to be used for diagnosis.

Knight & Lowenburg, of Boston, Mass., exhibited dental X-ray coils and switchboards, with equipment for making radiographs of the teeth along the lines indicated above. A feature of the convention was the holding of a large number of clinics at the Tufts Dental School, in which the facility of oral diagnosis by X-rays was thoroughly illustrated.

The DeVilbiss Manufacturing Company, of Toledo, Ohio, showed a special dental set arranged to heat two atomizers, a syringe, two tumblers and a bottle. The heater consisted of an ordinary 4-cp lamp, centrally placed in a brass case having pockets for the atomizers and other glass utensils. In this apparatus an adjusting screw in the bottom of the case enables any electric bulb to be used. A 2-cp lamp keeps the solutions at blood heat.

The Ritter Dental Manufacturing Company, of Rochester, N. Y., exhibited dental motors of 1/16 hp for engine work, with rapid-control rheostats. The motors of this type consume about 50 watts at 110 volts, and are provided with four speeds forward and reverse, the range being from 750 to 4200 r.p.m. This company also showed a lathe motor of 1/6 hp with four speeds forward and backward and a range from 800 to 3200 r.p.m.

The Holtzer-Cabot Electric Company, of Boston, Mass., displayed lathe motors and accessories, emphasizing its new multi-speed motor for both direct and alternating circuits. This motor is dust and moisture proof, can be attached to an ordinary lamp socket, has its full power on at all speeds, is provided with a tool rest adjustable to any position and has a rack for idle chucks.

Special telegraph, telephone and trolley facilities were available at the convention, and the electric lighting of displays, the use of low-powered bulbs to exhibit developed X-ray films, electric signs, etc., was well planned.

INTERIOR WIRING AND ILLUMINATION

Amperes in Alternating-Current Circuits.

By A. D. Williams, Jr.

The accompanying tables give the amperes per lead wire per kilowatt for single-phase and three-phase balanced loads. The single-phase table can be used for two-phase balanced loads by using a current value corresponding to twice the stated potential of the circuit or by dividing the current value at the potential of the circuit by two. That is, each wire of a two-phase circuit carries one-half of the current indicated at the load specified. These tables show the value of the current at power factors varying from unity to 70 per cent. The power of any circuit in kilowatts can, therefore, be computed by dividing the reading of the ammeter by the tabulated value corresponding to the measured power factor and voltage of the circuit. These values are correct only for a balanced load (and there is generally a slight unbalancing of the loads on the phases), but the table is useful in computing the sizes of wire required for transmission purposes.

This table was derived from the following formulas:

For single-phase circuits: Amperes per wire = watts ÷ (volts × power factor).

For three-phase circuits: Amperes per wire = total watts ÷ (volts between wires × power factor × $\sqrt{3}$).

For two-phase circuits: Amperes per wire = total watts ÷ (volts between wires of one phase × power factor × 2).

In making the computations the number of watts was assumed as 1000, and the amperes were computed for various values of e.m.f. to a sufficient number of decimal places to insure accuracy. The tables were then extended by multiplication and division. If desired, these tables can be further extended to cover voltages outside of their limits by using the tabular values corresponding to potentials of one-tenth (or 10 times) the desired potential, care being used to shift the decimal point in the proper direction.

The values for intermediate power factors can be approximated from the tables. For lower power factors, the value of the current for unity power factor can be divided by the actual power factor of the circuit or multiplied by the reciprocal of this power factor.

TABLE I.—SINGLE-PHASE CIRCUITS.

AMPERES FOR ONE KILOWATT AT DIFFERENT POWER FACTORS.

	Power factor in per cent.						
Volts.	100	95	90	85	80	75	70
100	10.0000	10.5263	11.1111	11.7647	12.5000	13.3333	14.2857
110	9.0909	9.5693	10.1010	10.6952	11.3636	12.1211	12.9870
115	8.6957	9.1533	9.6619	10.2302	10.8696	11.5942	12.4224
120	8.3333	8.7719	9.2592	9.8040	10.4166	11.1111	11.9049
125	8.0000	8.4211	8.8889	9.4118	10.0000	10.6667	11.4286
130	7.6923	8.0972	8.5470	9.0498	9.6154	10.2564	10.9890

Volts	100	95	90	85	80	75	70
140	7.1429	7.5188	7.9365	8.4034	8.9285	9.5238	10.2040
150	6.6667	7.0176	7.4074	7.8431	8.3333	8.8889	9.5239
160	6.2500	6.5790	6.9444	7.3529	7.8125	8.3333	8.9286
170	5.8824	6.1919	6.5360	6.9205	7.3530	7.8431	8.4034
180	5.5556	5.8480	6.1729	6.5359	6.9445	7.4074	7.9366
190	5.2632	5.5402	5.8480	6.1919	6.5790	7.0176	7.5189
200	5.0000	5.2632	5.5556	5.8824	6.2500	6.6667	7.1429
210	4.7619	5.0125	5.2910	5.6022	5.9524	6.3492	6.8027
220	4.5455	4.7847	5.0505	5.3476	5.6819	6.0606	6.4936
225	4.4444	4.6784	4.9382	5.2288	5.5556	5.9259	6.3492
230	4.3479	4.5766	4.8309	5.1151	5.4349	5.7971	6.2113
240	4.1667	4.3860	4.6296	4.9020	5.2084	5.5556	5.9524
250	4.0000	4.2105	4.4444	4.7059	5.0000	5.3333	5.7143
300	3.3333	3.5088	3.7037	3.9216	4.1666	4.4444	4.7614
330	3.0303	3.1897	3.3670	3.5651	3.7879	4.0404	4.3290
350	2.8572	3.0075	3.1746	3.3613	3.5715	3.8095	4.0817
400	2.5000	2.6316	2.7778	2.9412	3.1250	3.3333	3.5714
440	2.2727	2.3923	2.5252	2.6738	2.8409	3.0303	3.2467
450	2.2222	2.3392	2.4691	2.6144	2.7778	2.9630	3.1746
500	2.0000	2.1053	2.2222	2.3529	2.5000	2.6667	2.8571
550	1.8182	1.9139	2.0202	2.1390	2.2728	2.4242	2.5974
600	1.6667	1.7544	1.8519	1.9608	2.0834	2.2222	2.3810
700	1.4286	1.5037	1.5873	1.6807	1.7857	1.9048	2.0409
800	1.2500	1.3158	1.3889	1.4706	1.5625	1.6667	1.7857
900	1.1111	1.1696	1.2345	1.3072	1.3889	1.4815	1.5873
1,000	1.0000	1.0527	1.1111	1.1765	1.2500	1.3333	1.4286
1,100	0.9091	0.9569	1.0101	0.0695	1 1364	1.2121	1.2987
1,200	0.8333	0.8772	0.9259	0.9804	1.0417	1.1111	1.1905
1,300	0.7692	0.8097	0.8547	0.9050	0.9615	1.0256	1.0989
1,400	0.7143	0.7519	0.7936	0.8403	0.8929	0.9524	1.0204
1,500	0.6667	0.7018	0.7407	0.7843	0.8333	0.8889	0.9524
1,600	0.6250	0.6579	0.6944	0.7353	0.7812	0.8333	0.8929
1,700	0.5882	0.6192	0.6536	0.6921	0.7353	0.7843	0.8403
1,800	0.5556	0.5848	0.6173	0.6536	0.6944	0.7407	0.7937
1,900	0.5263	0.5540	0.5848	0.6192	0.6579	0.7018	0.7519
2,000	0.5000	0.5263	0.5556	0.5882	0.6250	0.6667	0.7143
2,100	0.4762	0.5013	0.5291	0.5602	0.5952	0.6349	0.6803
2,200	0.4545	0.4785	0.5050	0.5348	0.5682	0.6061	0.6494
2,300	0.4348	0.4577	0.4831	0.5115	0.5435	0.5797	0.6211
2,400	0.4167	0.4386	0.4630	0.4902	0.5208	0.5556	0.5952
2,500	0.4000	0.4210	0.4444	0.4706	0.5000	0.5333	0.5714
3,000	0.3333	0.3509	0.3704	0.3922	0.4167	0.4444	0.4761
3,300	0.3030	0.3190	0.3367	0.3565	0.3788	0.4040	0.4329
3,500	0.2857	0.3007	0.3175	0.3361	0.3571	0.3809	0.4082
4,000	0.2500	0.2632	0.2778	0.2941	0.3125	0.3333	0.3571
4,500	0.2222	0.2339	0.2469	0.2614	0.2778	0.2963	0.3175
5,000	0.2000	0.2105	0.2222	0.2353	0.2500	0.2667	0.2857
6,000	0.1667	0.1754	0.1852	0.1961	0.2083	0.2222	0.2381
6,600	0.1515	0.1595	0.1684	0.1783	0.1894	0.2020	0.2165
7,000	0.1429	0.1504	0.1587	0.1681	0.1786	0.1905	0.2041
8,000	0.1250	0.1316	0.1389	0.1471	0.1563	0.1667	0.1786
9,000	0.1111	0.1170	0.1234	0.1307	0.1389	0.1481	0.1587
10,000	0.1000	0.1053	0.1111	0.1177	0.1250	0.1333	0.1429
11,000	0.0909	0.0957	0.1010	0.1070	0.1136	0.1212	0.1299
12,000	0.0833	0.0877	0.0926	0.0980	0.1042	0.1111	0.1190
13,000	0.0769	0.0810	0.0855	0.0905	0.0962	0.1026	0.1099
14,000	0.0714	0.0752	0.0794	0.0840	0.0893	0.0952	0.1020
15,000	0.0667	0.0702	0.0741	0.0784	0.0833	0.0889	0.0952
16,000	0.0625	0.0658	0.0694	0.0735	0.0781	0.0833	0.0893
17,000	0.0588	0.0619	0.0654	0.0692	0.0735	0.0784	0.0840
18,000	0.0556	0.0585	0.0617	0.0654	0.0694	0.0741	0.0794
19,000	0.0526	0.0554	0.0585	0.0619	0.0658	0.0702	0.0752
20,000	0.0500	0.0526	0.0556	0.0588	0.0625	0.0667	0.0714
25,000	0.0400	0.0421	0.0444	0.0471	0.0500	0.0533	0.0571
30,000	0.0333	0.0351	0.0370	0.0392	0.0417	0.0444	0.0476
35,000	0.0286	0.0301	0.0317	0.0336	0.0357	0.0381	0.0408
40,000	0.0250	0.0263	0.0278	0.0294	0.0313	0.0333	0.0357
45,000	0.0222	0.0234	0.0247	0.0261	0.0278	0.0296	0.0317
50,000	0.0200	0.0211	0.0222	0.0235	0.0250	0.0267	0.0286
55,000	0.0182	0.0191	0.0202	0.0214	0.0227	0.0242	0.0260
60,000	0.0167	0.0175	0.0185	0.0196	0.0208	0.0222	0.0238

TABLE II.—THREE-PHASE CIRCUITS.

AMPERES PER WIRE FOR ONE KILOWATT AT DIFFERENT POWER FACTORS.

Power factor in per cent.

Volts.	100	95	90	85	80	75	70
100	5.7735	6.0774	6.4150	6.7924	7.2169	7.6980	8.2479
110	5.2486	5.5249	5.8319	6.1749	6.5608	6.9982	7.4980
115	5.0204	5.2847	5.5783	5.9064	6.2756	6.6939	7.1721
120	4.8112	5.0645	5.3458	5.6603	6.0141	6.4150	6.8732
125	4.6188	4.8619	5.1320	5.4339	5.7735	6.1584	6.5983
130	4.4411	4.6749	4.9346	5.2249	5.5514	5.9215	6.3445
140	4.1240	4.3410	4.5821	4.8517	5.1549	5.4986	5.8913
150	3.8490	4.0516	4.2767	4.5283	4.8112	5.1320	5.4986
160	3.6084	3.7984	4.0094	4.2453	4.5105	4.8112	5.1549
170	3.3962	3.5749	3.7735	3.9955	4.2453	4.5282	4.8517
180	3.2075	3.3763	3.5639	3.7735	4.0094	4.2767	4.5821
190	3.0387	3.1986	3.3763	3.5749	3.7984	4.0516	4.3410
200	2.8867	3.0387	3.2075	3.3962	3.6084	3.8490	4.1239
210	2.7493	2.8940	3.0548	3.2345	3.4366	3.6657	3.9276
220	2.6243	2.7624	2.9159	3.0874	3.2804	3.4992	3.7490
225	2.5660	2.7010	2.8511	3.0188	3.2075	3.4213	3.6657
230	2.5102	2.6423	2.7891	2.9532	3.1378	3.3470	3.5860
240	2.4056	2.5322	2.6729	2.8301	3.0070	3.2075	3.4366
250	2.3094	2.4310	2.5660	2.7170	2.8867	3.0792	3.2992
300	1.9245	2.0258	2.1384	2.2642	2.4056	2.5660	2.7493
330	1.7495	1.8416	1.9439	2.0583	2.1869	2.3327	2.4960
350	1.6496	1.7364	1.8328	1.9406	2.0620	2.1994	2.3566
400	1.4434	1.5194	1.6038	1.6981	1.8042	1.9245	2.0620
440	1.3122	1.3812	1.4579	1.5437	1.6402	1.7495	1.8745
450	1.2830	1.3505	1.4256	1.5094	1.6037	1.7107	1.8329
500	1.1547	1.2155	1.2830	1.3585	1.4434	1.5396	1.6496
550	1.0497	1.1050	1.1664	1.2350	1.3121	1.3996	1.4996
600	0.9622	1.0129	1.0692	1.1321	1.2028	1.2830	1.3746
700	0.8248	0.8682	0.9164	0.9703	1.0310	1.0997	1.1783
800	0.7217	0.7597	0.8019	0.8491	0.9021	0.9623	1.0310

Volts	100	95	90	85	80	75	70
900	0.6415	0.6753	0.7128	0.7547	0.8019	0.8553	0.9164
1,000	0.5774	0.6077	0.6415	0.6792	0.7217	0.7698	0.8248
1,100	0.5249	0.5525	0.5832	0.6175	0.6561	0.6998	0.7498
1,200	0.4811	0.5064	0.5346	0.5660	0.6014	0.6415	0.6873
1,300	0.4441	0.4675	0.4935	0.5225	0.5551	0.5922	0.6344
1,400	0.4124	0.4341	0.4582	0.4852	0.5155	0.5499	0.5891
1,500	0.3849	0.4052	0.4277	0.4528	0.4811	0.5132	0.5499
1,600	0.3608	0.3798	0.4009	0.4245	0.4511	0.4811	0.5155
1,700	0.3396	0.3575	0.3774	0.3996	0.4245	0.4528	0.4852
1,800	0.3207	0.3376	0.3564	0.3773	0.4009	0.4277	0.4582
1,900	0.3039	0.3199	0.3376	0.3575	0.3798	0.4052	0.4341
2,000	0.2887	0.3039	0.3207	0.3396	0.3608	0.3849	0.4124
2,100	0.2749	0.2894	0.3055	0.3234	0.3437	0.3666	0.3928
2,200	0.2624	0.2762	0.2916	0.3087	0.3280	0.3499	0.3749
2,300	0.2510	0.2642	0.2789	0.2953	0.3138	0.3347	0.3586
2,400	0.2406	0.2532	0.2673	0.2830	0.3007	0.3208	0.3437
2,500	0.2309	0.2431	0.2566	0.2717	0.2887	0.3079	0.3299
3,000	0.1924	0.2026	0.2138	0.2264	0.2406	0.2566	0.2749
3,300	0.1749	0.1842	0.1944	0.2058	0.2187	0.2333	0.2499
3,500	0.1650	0.1736	0.1833	0.1941	0.2062	0.2199	0.2357
4,000	0.1443	0.1519	0.1604	0.1698	0.1804	0.1924	0.2062
4,500	0.1283	0.1350	0.1426	0.1509	0.1604	0.1711	0.1833
5,000	0.1155	0.1216	0.1283	0.1358	0.1443	0.1540	0.1650
6,000	0.0962	0.1013	0.1069	0.1132	0.1203	0.1283	0.1375
6,600	0.0875	0.0921	0.0972	0.1029	0.1093	0.1167	0.1249
7,000	0.0825	0.0868	0.0916	0.0970	0.1031	0.1100	0.1178
8,000	0.0722	0.0760	0.0802	0.0849	0.0902	0.0962	0.1031
9,000	0.0641	0.0675	0.0713	0.0755	0.0802	0.0855	0.0916
10,000	0.0577	0.0608	0.0642	0.0679	0.0722	0.0770	0.0825
11,000	0.0525	0.0552	0.0583	0.0617	0.0656	0.0700	0.0750
12,000	0.0481	0.0506	0.0535	0.0566	0.0601	0.0642	0.0687
13,000	0.0444	0.0467	0.0493	0.0522	0.0555	0.0592	0.0634
14,000	0.0412	0.0434	0.0458	0.0485	0.0515	0.0550	0.0589
15,000	0.0385	0.0405	0.0428	0.0453	0.0481	0.0513	0.0550
16,000	0.0361	0.0380	0.0401	0.0425	0.0451	0.0481	0.0515
17,000	0.0340	0.0357	0.0377	0.0399	0.0425	0.0453	0.0485
18,000	0.0321	0.0338	0.0356	0.0377	0.0401	0.0428	0.0458
19,000	0.0304	0.0320	0.0338	0.0357	0.0380	0.0405	0.0434
20,000	0.0289	0.0304	0.0321	0.0340	0.0361	0.0385	0.0412
25,000	0.0231	0.0243	0.0257	0.0272	0.0289	0.0308	0.0330
30,000	0.0192	0.0203	0.0214	0.0226	0.0241	0.0257	0.0275
33,000	0.0175	0.0184	0.0194	0.0206	0.0219	0.0233	0.0250
35,000	0.0165	0.0174	0.0183	0.0194	0.0206	0.0220	0.0236
40,000	0.0144	0.0152	0.0160	0.0170	0.0180	0.0192	0.0206
45,000	0.0128	0.0135	0.0143	0.0151	0.0160	0.0171	0.0183
50,000	0.0115	0.0122	0.0128	0.0136	0.0144	0.0154	0.0165
55,000	0.0105	0.0111	0.0117	0.0124	0.0131	0.0140	0.0150
60,000	0.0096	0.0101	0.0107	0.0113	0.0120	0.0128	0.0137

Insulation Resistance and Other Tests in Completed Electrical Installations.

BY HUGH T. WREAKS.

In order to keep down the fire hazard in the use of electricity for light and power, and to prevent danger from stray current due to grounds and crosses, much effort has been expended by insurance companies, whose interests in the premises are most direct, to see that all material used in electrical installations is up to what they consider reliable standards.

Electrical representatives of the insurance interests have devoted much time and experience to the framing of such standards during the last 16 years, and have been aided by many suggestions submitted by corporate and individual interests in the electric light and power industries, so that to-day the National Electrical Code is a recognized authority in the electrical world.

Practically considered, however, the value of these standards must depend, first, on how closely electrical material used is manufactured to meet them, and, second, how well such standard material bears the stress of time and maintains a lower average of fire hazard, due to its use, than similar non-standard material.

The first point is a question, pure and simple, of inspection, either field or factory, or both, and can be verified through proper tests and supervision. The second point is not, however, so easily settled, as it involves not only the manufacture of material, but its use and, while the former is capable of some control, the latter can only be controlled with extreme difficulty.

Moreover, unless the thought of standardization is carried a step further and we have a practical test for installations, just as we have a standard for the material which goes into these installations, it would seem that the system for keeping down the fire hazard of electricity is incomplete. In other words, it is very easy to conceive of a building which is equipped with material which has passed every requirement of the standards laid down in National Electrical Code and on which inspection

apparently shows a proper use of the various articles going into this installation, yet there may still remain one or more weak points, which, if neglected, would cause leaks or grounds sufficiently serious to vitiate the value of the entire installation.

This thought has been recognized by the framers of the National Electrical Code and a standard for complete installations exists in Code, Rule 66, as follows:

"The wiring in any building must test free from grounds, i. e., the complete installation must have an insulation between conductors and between all conductors and the ground, not including attachments, sockets, receptacles, etc., of not less than that given in the following table:

5 amp	4,000,000	ohms
10 amp	2,000,000	ohms
25 amp	800,000	ohms
50 amp	400,000	ohms
100 amp	200,000	ohms
200 amp	100,000	ohms
400 amp	50,000	ohms
800 amp	25,000	ohms
1,600 amp	12,500	ohms

and test must be made with all cut-outs and safety devices in place. If the lamps, sockets, receptacles, electroliers, etc., are also connected, only one-half of the resistance specified in the table will be required."

These requirements are quite comprehensive, except that there is no mention as to the voltage at which such tests should be made. This omission was probably intentional, for the reason that until quite recently the practical usable voltage for tests of this nature has been low—often so low, in fact, as not to give the standard in question much real value.

As far as the writer knows, for this or other reasons, tests made under these standards have not been highly thought of by inspectors in the field. Or, to be specific, tests of this nature are generally made either with a Wheatstone bridge and a few cells of battery or with a voltmeter and a voltage not to exceed 110 volts, and, in neither case would the instruments used have sufficient sensitiveness or the voltage be sufficiently high to have the searching qualities that would make these tests of real value. And as such tests made in this way will only give negative results and if made in a building that is perfectly dry and without any earth connections present, might not even detect bad joints or inferior insulation of wiring, the impression obtains that the tests specified are of little value on completed installations.

This impression the writer believes to be ill-founded, as his own experience shows that valuable results can be obtained along these lines, provided the instruments used for measuring are sufficiently sensitive and the voltage used is sufficiently high. A voltage of 500, or even 1000, is by no means impractical and with a proper galvanometer and a constant of 8000 megohms one can measure with a fair degree of accuracy 2000 to 3000 megohms of insulation resistance with the mirror and scale 6 in. apart.

The writer, with the co-operation of Electrical Engineer Hubert S. Wynkoop and Inspector Edward L. Sullivan, of the Borough of Brooklyn, has recently made some tests along these lines, using a Leeds & Northrup portable telescope galvanometer and a voltage from 125 to 500 volts. Some of these tests might be of interest and are briefly sketched below.

Installation No. 1.—About 15 years old, consisting of old fiber conduit laid in plaster. Test on window-light circuit of 150-amp capacity, containing various combination fixtures, showed a dead ground. Test on a show-case circuit of 25-amp capacity, straight electrical fixtures, gave a reading of 1.6 megohms. Test on tower circuit, 30-amp capacity, straight electrical fixtures, gave a reading of 10,000 ohms. Test on two ceiling-light circuits, 80-amp capacity, gave a reading of 1.7 magohms each.

Installation No. 2.—This was a relatively new installation and consisted of molding with branch sockets and wiring fished between floor and ceiling. Test made on the mains of circuit No. 1 gave an insulation resistance of 130,000 ohms. Test made on complete circuit fed by this main and with all outlets in circuit, circuit capacity being 125 amp, gave a resistance of 100,000 ohms.

These tests on installations 1 and 2 were simply tests to ground.

Installation No. 3.—This installation was 15 years old with wires laid in molding and concealed in plaster. A test made on circuit No. 1 gave 80 megohms on one leg of three-wire circuit and 64 on the other. On circuit No. 2 a test gave a reading of between 200 and 300 megohms on one leg, the other leg apparently containing a lamp connected in place and showing a closed circuit. A ground test on both circuits gave between 200 and 300 megohms. In this installation it was impossible to obtain the number of amperes for which each circuit was wired.

Installation No. 4.—Tests were made on a new job, complete conduit construction, and no readings indicating any resistance to ground were obtained, only 125 volts being used in this case.

Installation No. 5.—This consisted of open knob and cleat wiring, about 30-amp capacity, grounded circuit. Here again no insulation leakage was noted, although in this case 540 volts were used; the tests, however, were made under extremely dry conditions and the insulation leakage would, naturally, be extremely small, especially so as the wires did not run even through any walls or floors.

Analyzing these tests to a certain extent, and taking the most interesting one, which was the dead ground recorded in the first installation, this condition means that the resistance to ground would be, probably, a few hundred ohms, not sufficient to consume more current than would be used by an ordinary 16-cp incandescent lamp, and, therefore, not noticeable under commercial conditions and when using the balance of the light. But a source of potential danger unquestionably existed there which, under condition of dampness, might easily result in the reduction of this resistance to a few ohms and give rise to sufficient leakage in the insulation to generate heat and cause a fire.

Conversely, the majority of the other tests, which show from 100,000 ohms to 200 and more megohms, or 200 times 1,000,000 ohms resistance, would indicate that a considerable degree of deterioration or moisture would be necessary before these circuits would become dangerous, even though it may be conceded as possible that there would be points in such tested circuits which showed a high insulation resistance reading under dry conditions without absolutely being in first-class condition. It might be argued that this vitiated the value of such tests, yet this line of argument would also belittle the value of insulation resistance tests at factory on wire, insulating joints, cord, canopy insulators, armored cables and other material on which they might be applied, as even in these tests all inherent weaknesses could not be developed by the instruments used. Just as in factory tests, there would still be the necessity for observing workmanship, material, etc., so even with the use of instruments on installations, trained inspectors would still be required to check points not measurable with apparatus. Conversely, any electrical inspector would be better equipped to pass intelligently on the electrical features of an installation if, to his trained faculties of observation, were added the use of practical testing apparatus, and such apparatus is to-day obtainable.

Further than this, these tests, if made periodically, would, by comparison, show very quickly any deterioration in any individual circuit and though, from their nature, they would be too expensive to make frequently on private dwellings, yet in hotels, theaters, department stores, warehouses, refineries, breweries, car barns and various factories subject to moisture and acid fumes, tests of this kind would certainly be of value and calculated to complete the scheme of supervision of electrical devices now pursued by the insurance interests for the reduction of fire hazard.

It is of interest to turn to the rules of the Institution of Electrical Engineers of London, under date of June, 1907. These rules are much less specific than the rules of the National Electrical Code in most details, but are more specific on the question of tests on complete installations, and the record of fire losses in England, compared with those in the United States, might indicate that the importance they attach to tests of this nature is not unwarranted. To quote at length:

"The insulating resistance to earth of the whole or any part of the wiring must, when tested previous to the erection of fittings and electroliers, be measured with a pressure not less than twice the intended working pressure and must not be less in megohms than 30 divided by the number of points under test.

"For this purpose the points are to be counted as to the number of pairs or terminal wires from which it is proposed to take current, either directly or by flexibles, to lamps or other appliances.

"The current must not be switched on until the following test has been applied to finished wire: All lamps having been connected to the conductors and all switches and fuses being on, a pressure equal to twice the working pressure must be applied and the insulation of the whole or any part of the installation must not be less in megmohms than 25 divided by the number of lamps.

"When all lamps and appliances have been removed from the circuit, the insulation resistance between conductors must not be less than 25 megohms divided by the number of lamps. The insulation of any individual subcircuit must not fall below 1 megohm.

"Any motor, heater, arc lamp or other appliance may be connected to the supply of electrical energy, provided that the insulation of the parts carrying the current measured as above is greater than 1 megohm from the frame to the case.

"The value of systematical inspecting and testing apparatus and circuits cannot be too strongly urged. Record should be kept of all tests so that any gradual deterioration of the system may be detected."

The rules from which these extracts are made are apparently endorsed by all the leading English fire insurance companies.

Commenting once more on the value of these tests it will probably be conceded that the greatest danger of fire in any electrical installation comes from those parts of the installation which are concealed from view, and once intelligently tested and found satisfactory, these parts would certainly be little liable to effects of moisture and mechanical injury sufficient to change their condition, except, of course, through lapse of time.

Insulation resistance tests, therefore, would seem to be of value where most needed, always provided that they are properly and thoroughly made. It would almost seem as if the necessity of tests of this kind would be obvious from the intangible nature of the electrical circuit furnishing light and power, as no evidence of the senses alone could tell when an installation was or was not in good condition, differing in this respect from gas and water, although the latter is not, of course, a fire hazard.

The practical nature of these tests would also seem to be apparent when it is considered that, without a test of this nature, installations might be condemned on account of age, while still in condition to give may years of good service and, on the other hand, installations might remain in service on which radical and important changes were necessary.

It is, of course, recognized that the value of these tests would be greatly increased if they could be supplemented by a practical jump-spark test which would indicate surface leakage at various points, due to surface hydroscopic action too faint to be determined by the galvanometer test referred to, or in determining close proximity of exposed points of different polarity, which points are still sufficiently separated not to be measurable in insulation resistance, and the writer firmly belives that such tests will be found to be practical in the near future.

But at present no sparking device seems to be on the market which can operate constantly at a sufficiently fixed voltage and through a sufficiently fixed spark-gap distance to make such tests of a comparative value.

Owing to the importance to the questions outlined here and the hundreds and millions of dollars of various interests involved in the interpretation of the two sides of the electrical fire hazard question, the writer feels this article may be of interest, and hopes it will tend to promote discussion and solution of a problem on which considerable thought could be devoted to advantage.

New Telephone Patents.

NEW APPARATUS.

Two different trunk circuits, each covered by its own patent, have been invented by I. Kitsee, of Philadelphia. In both the invention relates principally to the signal system. In one the circuits are so arranged that the insertion of a plug at either end sets a busy lamp at the near end and a call lamp at the farther end, the trunks being used upon the ring-down basis. With the other system, a single lamp at each end suffices for all signals. When the trunk is in use these lamps glow steadily, while a call is indicated by the flashing of the two lamps.

A swivel joint for the wires of portable telephones has been invented by Mr. H. A. Black, of Toledo, Ohio. This joint is adapted to prevent an excessive twisting of the wires. It consists of two telescoped tubes, each carrying terminals for two wires. These tubes cannot separate, but can revolve, one within the other. A brush device serves to maintain the two electrical circuits through the device.

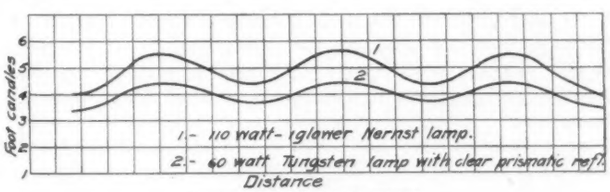
Messrs. H. B. DeGroot and W. A. Kendrick, of Washington, D. C., have patented jointly a railway signaling system adapted for the sending of signals and communications between moving trains upon the same block. A signal rail must be laid parallel to the main rails. Each train has a buzzer which generates interrupted currents. These are applied to the signal rail through a telephone receiver. They do not become effective, however, until the signal and main rails become connected together at some block station, or through another train entering the block. Under either condition, a "howl" is set up at both receivers and both points are signaled.

LETTERS TO THE EDITORS.

Nernst Lamp Efficiency.

To the Editors of Electrical World:

SIRS:—Referring to the article on page 89 of your issue of July 11 under the heading of "Helps in Rapid Preliminary Calculation of Illumination," by Messrs. J. R. Cravath and V. R. Lansingh, I desire to warn all prospective purchasers of illuminating devices to accept no figures on the efficiency or installation of Nernst lamps, except as furnished by official representatives of the Nernst Lamp Company, as it is becoming very tiresome and annoying to note the very many inaccurate and unfair comparisons which have recently been appearing in various publications.



NERNST LAMP EFFICIENCY.

The authors of the article in question confine their data on Nerst lamps to one unit. As a matter of fact, distribution curves which have been given wide publicity through the technical press indicate that this unit has a mean hemispherical efficiency of 1.37 when equipped with clear glassware and 1.65 when equipped with alabaster glassware. These tests were made by the Electrical Testing Laboratories over a year ago.

The mean hemispherical efficiency of the clear tungsten lamp equipped with a clear prismatic bowl reflector is approximately 1.125, and when equipped with an enameled bowl reflector, is, according to the figures of the authors, approximately 1.35, as the loss in absorption of the enameled bowl reflector is approximately 16 per cent, so that, without taking into consideration the effect of reflection, which certainly would be as much in the case of the Nernst system as in the tungsten system, it is readily to be noted that instead of the Nernst system requiring

twice as much current for equal illumination, it would not require more than the difference between the relative efficiency of the two systems. In the case of lamps equipped with clear glassware it would be as 1.125 is to 1.37, and in the case of diffusing glassware as 1.35 is to 1.65. This is further borne out by the following figures, which are calculated from the curve of the tungsten lamp as given in the *N. E. L. A. Bulletin* No. 6 B.

For illustration, take the room 40 ft. x 40 ft., where an illumination of 4 foot-candles is desired, using tungsten lamps. From the authors' table we find: Total watts $= 40 \times 40 \times 4 \times 0.25$ or 1600, of 27 60-watt lamps. Since the authors selected 30 110-watt Nernst lamps to be placed in five rows of six each, it will be desirable to increase the number and use 30 60-watt tungsten lamps, thus placing both systems on an equality so far as outlets are concerned. The curves represent the calculated intensity down the center of the room with the lamps 8 ft. above the working plane. An average intensity from the 110-watt Nernst lamp of approximately 4.78 foot-candles will be found, and from the 60-watt tungsten approximately 3.93 foot-candles, showing that without considering aid from reflection, the 110-watt Nernsts on the one hand give more than the desired intensity and the tungsten less, so that to summarize this matter, the least that could be given for the 110-watt units would be a factor of 0.366 instead of the factor 0.5.

In the case of a reasonably large interior, it is generally conceded that the use of a large number of light sources is not desirable, and this is further borne out by the fact that the manufacturers of tungsten lamps are advocating the installation of such lamps for large interiors in connection with "luminеers," "luxoliers" and other similar fixtures. The mean hemispherical efficiency of the five-light, 500-watt "lumineer" or "luxolier" is approximately 1.5 when equipped with tungsten lamps, having a rated mean horizontal efficiency of 1.25 watts per candle, when furnished with sand-blasted tipped bulbs and enameled bowl reflectors. For such installations the standard six-glower Nernst lamps equipped with diffusing glassware and having a mean hemispherical efficiency of 1.64, would be used at the present time. Without taking into consideration reflection, the factor for the tungsten system when so equipped would have to be changed from 0.29 to 0.322, whereas the factor for the Nernst system in such case would be 0.366.

We note with considerable surprise that the figures furnished are based on the installation of units at heights varying from 8 ft. to 15 ft., and we cannot agree with the authors that these figures are of any particular value, in view of the fact that they are furnished for such a wide range of elevations. It is readily apparent that the factor used for an installation where the elevation is 8 ft. would not be of any value where the elevation is 15 ft., and while the illuminating engineer could readily work this back, there are many who will read the article and use these figures, without understanding the principles of illuminating engineering sufficiently well to work out their own correction factors.

As there are undoubtedly cases now under consideration by architects, illuminating engineers and others where the installations will not be made for several months, in view of the introduction of the new high-efficiency Westinghouse Nernst units, which will be placed on the market about Aug. 1, 1908, and whose efficiency will be such as to materially change these figures and make a still better showing than the figures herein submitted for the 110-watt and the present six-glower lamps, those interested are respectfully requested to submit their problems to the Nernst Lamp Company, which will be very pleased to furnish them with the desired information.

Pittsburg, Pa. A. L. Eustice,
Illuminating Engineer, Nernst Lamp Company.

Magnetic Steel.

To the Editors of Electrical World:

Sirs:—In your issue of Aug. 1 in an article on "New Magnetic Steel" my connection with the introduction of silicon steel for magnetic purposes is mentioned, and it is added that "At that time, however, difficulties at the mills in obtaining the materials prevented its use." This statement is erroneous. There were no difficulties at the mills such as to prevent the introduction into commercial use of silicon steel, though as stated in the patent (No. 570,319, Oct. 27, 1896), great care had always to be exercised in annealing. There was at first some difficulty in obtaining the raw material, and the first ton of billets was actually imported from France. These billets were rolled by the Wellsville Sheet Iron & Steel Company, of Wellsville, Ohio. After the experience obtained in this way, the Wellsville company found itself able to attend to the whole of the production. The silicon steel was supplied by the Stanley Company to its customers in transformers and generators at least up to the end of my active connection with the company, say something like seven years. This would coincide with the time at which the General Electric Company obtained control of the Stanley Company. I cannot speak from my own knowledge as to the occurrences after the time mentioned, but I have every reason to believe that the use of silicon steel was continued for a long period thereafter.

Pittsfield, Mass. John F. Kelly.

The Circular Current Locus.

To the Editors of Electrical World:

Sirs:—In an editorial in the Electrical World for July 11, 1908, under the heading, "The Exact Circular Current Locus of the Induction Motor," use was made of the expression, "Behrend-Heyland circle diagram."

The facts are that Heyland published the diagram in 1894 in the *Electrotechnische Zeitschrift*, on page 561, whereas Behrend brought it forward in the same paper in 1896, on page 63. Further Behrend published an article on the same subject in the Electrical World and Engineer in 1900, on page 676, where, in a footnote, he admits Heyland's priority, referring to certain letters Heyland wrote to the *Electrotechnische Zeitschrift* in 1896, without, however, referring to Heyland's original article published in 1894.

The question as to who first published the diagram has been fully thrashed out in the *Electrotechnische Zeitschrift* years ago, and there should not at the present time exist any doubt that Heyland was the one who first brought out the diagram.

It is always a difficult matter to settle questions like the one involved, but if it is once settled, I think we should all try to call a thing by its right name, and I, therefore, would suggest that the Electrical World write "Heyland diagram" instead of "Behrend-Heyland diagram."

Edgewood Park, Pa. Jens Bache-Wiig.

[The term "Behrend-Heyland" was used for the purpose of specifying a particular form of circular current locus of the induction motor, without any intention of giving credit to either Mr. Behrend or Mr. Heyland for priority. It is greatly to be doubted whether credit for originating the so-called "circle diagram" will ever be placed to the satisfaction of all persons, because Mr. Behrend and Mr. Heyland, working independently and simultaneously, obtained almost identical solutions; moreover, their independent publications overlapped in time.—Eds.]

Electrical Contractors.

To the Editors of Electrical World:

Sirs:—It was with much interest that I read the article on co-operation between central stations and contractors, by E. F. Tweedy, in the issue of July 11. The author of this article is apparently of the opinion that plenty of capital and a brave show window will make an electrical contractor out of anyone who has the aforesaid assets, and that a man who starts in a modest way, but with a full knowledge of the how and why

of everything that he does, is nothing but a "grip-sack contractor."

Be that as it may, the writer has on many occasions taken on himself the privilege of looking over work done by both classes of contractors, and he is happy to say that almost without exception the work of the "grip-sack contractor" has been up to the underwriters' requirements, while on the other hand, much of the work done by the "capitalized contractor" has been rotten to the core, and if accorded the same careful inspection which the "grip-sack contractor's" almost always receives, would have been turned down flat.

The writer does not presume to leave the impression that the work done by either class is all good or all bad, by any means, but he does want to see fair play accorded to the man who is making his start in a small way and who has the brains that no capital on earth can buy and who some day may be a credit to the electrical world.

While the writer has the subject in hand he would like to say a word with regard to the licensing of contractors and the certification of wiremen. It has come to the writer's attention that the license, spoken of by the contractor, is usually coupled with a fee which the "capitalized contractor" feels sure will clear the field of all hindering competition and give him full swing. To my mind a license of this kind should require only a nominal fee which would not drive the competent but deserving man from the field, but which would serve to bring him face to face with the proposition in the light of a business undertaking and not a pastime. With reference to the certification of wiremen, the writer thinks that it would be well for contractor, as well as wireman, to pass an examination on which his eligibility to license would be determined.

Fort Wayne, Ind. Paul F. Shivers.

Damped Oscillations from Mercury Spark Gap.

To the Editors of Electrical World:

Sirs:—Your issue of June 6, 1908, contains an abstract of a paper by the writer recently published in the *Transactions* of the German Physical Society on the subject of the mercury spark-gap and its application to the production of slightly damped oscillations. This paper was, as published, supplemented by an appendix, which probably was overlooked in making the abstract, wherein it was stated that this utilization of the mercury spark-gap had previously been described in January, 1907, by R. H. Reudahl in a patent application of the Telefunken Company, the patent later being duly issued. On the basis of this patent application, therefore, the priority belongs to Mr. Reudahl and the Telefunken Company. To avoid any misunderstanding I would be obliged if you would kindly print this acknowledgment of priority.

Technische Hochschule, Berlin. Br. Glatzel.

Insulated Flexible Couplings.

To the Editors of Electrical World:

Sirs:—Mr. Herlan's letter on page 1338 of your issue of June 20, 1908, and the press notice on page 1113 of your issue of May 23, 1908, show how far an idea can travel, and how easy it is to misplace the credit for ideas. The coupling as illustrated is an exact copy of my invention which was designed for the General Electric Company at Schenectady in the fall of 1896, it being then first used on a motor generator set consisting of synchronous motor and two 100-kw low-tension direct-current machines running at 400 r.p.m., which the New York Edison Company installed in one of its substations just about the time of the general election that year. The General Electric Company and the British Thomson-Houston Company at Rugby, England, have made a very large number of these couplings and always with a considerable success.

The vibration mentioned by Mr. Herlan was not brought to my attention until within a year or two, and proved to be not due to the fact of any insufficiency in the design, but it was found that the couplings were out of balance due to the fact that the rubber cylinders were not uniform in length or density. As soon as this feature was corrected, vibration disappeared. In the original design the rubber buffers were held in place by a separate plate fixed to each arm. The sheet iron disk substituted by the British Thomson-Houston Company and the snap ring substituted by the Nuttall Company are the only modifications.

Rugby, England. W. F. Dawson.

Invention of the Repulsion Motor.

To the Editors of Electrical World:

Sirs:—Referring to the letter of Mr. Latour, published in your issue of June 20, I should like to call the attention of those interested in the development of the single-phase commutator motor to the English patent No. 23,288. This describes the general form of the repulsion motor and the excitation of such a motor by means of the armature, while the working brushes might either be short-circuited or connected to a supply circuit. This patent, furthermore, discloses the so-called series repulsion motor, of which recently some special forms have been published.

The English patent was applied for on Oct. 24, 1902, and is identical with the first original application which the late Mr Winter and myself filed in the United States of America on June 11, 1902.

Berlin, Germany. F. Eichberg.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Direct-Current Converter, with Variable Voltage.—L. Fleischmann.—An illustrated description of a converter which changes direct current of constant voltage into direct current of variable voltage and which is said to be especially suitable for arc lamps. It is a modification of the Rosenberg dynamo, which has two sets of brushes, one being short-circuited. If the latter set is not short-circuited, but connected to a variable resistance R, and if the other set of brushes is connected to a constant-voltage network the speed of the machine will change according to the value of R. This will be the case whether the machine performs external work or not. In the latter case it acts merely as a converter. Since the square of the speed is approximately proportional to R, it will be seen that for an infinite value of R (that is, when the circuit is opened) the speed would tend to become infinitely great; that is, the machine would run away. In order to prevent this, coils w_4, in Fig. 1, are arranged so that they produce a flux in the same direction as the armature ampere-windings in the circuit v_1 v_2. The circuit connected to the brushes v_1 and v_2 contains the arc lamps, etc., while the brushes b_1 and b_2 are connected to the 110-volt network. Since the voltage between v_1 and v_2 increases with increasing speed, it will be seen that even if the circuit connected to v_1 and v_2 is open, a sufficiently strong flux is produced which prevents the armature from running away. Although the voltage of this machine varies automatically with the resistance R, this is not yet sufficient for a converter for arc lamps which are to be operated without series resistance. For this purpose it is also

necessary that while the resistance varies (from the short-circuit of the arc carbons to the drawn-out arc), the machine should give almost constant current. This is accomplished by the provision of three further windings, as shown in the illustration: w_1 is connected to the constant voltage of the network; w_2 is connected to the variable voltage of the arc-lamp circuit, while the variable current of the arc-lamp circuit passes through the windings w_3. When the arc lamp is short-circuited no current passes through w_2. The windings w_3 and w_1 are so arranged that they oppose each other in their magnetizing effect and the numbers of windings are so chosen that at short-circuit

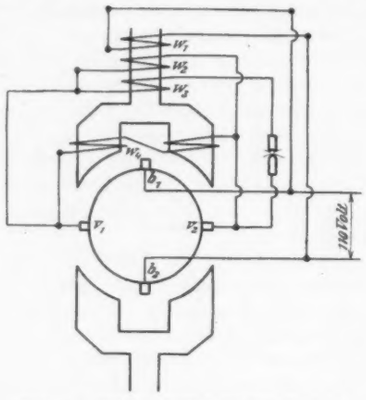


FIG. 1.—DIRECT-CURRENT CONVERTER.

the current cannot rise above the normal lamp current. When the resistance of the lamp circuit increases, then in order to keep the current in this circuit approximately constant, the excitation of the field must be increased. This is done by the windings w_2 through which more current passes when the voltage at the brushes v_1 and v_2 increases; w_2 is so wound that w_1 and w_2 aid each other in their magnetizing effect. Fig. 2 shows the results of a machine of this kind when tested on a 110-volt network. The short-circuit was 135 amp and for all voltages between 10 and 55 volts the current was approximately constant and equal to 115 amp. The maximum efficiency is 76.5 per cent. The commutation of the machine is good for all currents and speeds.—*Elek. Zeit.*, July 16.

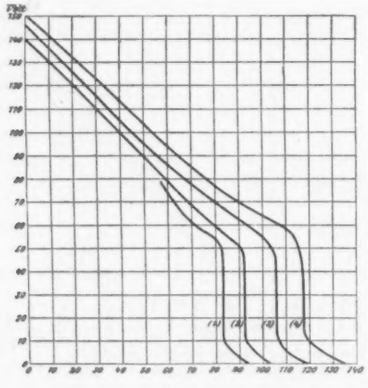


FIG. 2.—BEHAVIOR OF MACHINE.

Standardization Rules in Sweden.—A. Westerberg.—The electrical section of the Swedish Association of Engineers has adopted standardization rules for testing and rating electric machines and transformers. These rules have been adopted provisionally for the year 1908. In many respects they are similar to the German rules, but differ in others. The rules as to the increase of temperature are given under the assumption that the temperature of the machine room is not above 35 deg. C., and are as follows: The maximum increase of temperature permitted at normal operation is for insulated windings, 50 deg. C. with cotton insulation, 60 deg. C. with paper insulation, and 80 deg. C. for mica and asbestos insulation. These figures relate to revolving windings, while for stationary ones values 10 per cent higher are permitted. For windings which are continually short-circuited these rules do not hold. For laminated iron an increase of temperature of 60 deg. C. is permitted, for the bearings 40 deg. C., and for the commutators 60 deg. C. The temperature increase of windings is found from resistance measurements. If that is not possible, thermometers are to be applied. The temperature coefficient of the resistance of copper is assumed as 0.004. The temperature increase of the other parts of the machine is found by thermometers and these are to be placed always at the hottest accessible point of the machine and transformers. Up to 3300 volts the machines are to be tested for insulation with three times their normal voltage, but at least with 700 volts. Above 3300 volts machines and transformers are to be tested with one and one-half times the normal voltage plus 5000 volts. The test is to be carried out when the machine is hot and has to last one minute. The testing voltages relate to the insulation of the windings from the iron and of electrically-separated windings from each other. The above figures are valid when direct current machines are tested with direct-current and alternating-current machines with alternating current. If the direct-current winding is tested with alternating current, the testing voltage is to be only 70 per cent of the above value. If an alternating-current winding is tested with direct current the testing voltage is to be increased by 40 per cent.—*Elek. Zeit.*, July 16.

High-Speed Induction Motors.—G. Lewinnek.—High-speed induction motors are used to a considerable extent for driving centrifugal pumps. Several features of the construction of such motors, with horizontal or vertical design, are discussed. The higher the speed the greater is the difficulty of conducting away the heat generated in the motor. The author describes methods of ventilation and the cooling of bearings with oil lubrication. The vessel containing the oil is cooled by water pipes and the oil after having been used on the bearings is returned to the vessel to be cooled.—*Elek. Zeit.*, June 2.

Examination of Armature Windings.—P. Girault.—In winding armatures for commutator machines, it sometimes happens that a series winding becomes a series-parallel winding or reversely. The author describes a simple testing method to determine quickly the character of the winding.—*La Lumière Elec.*, July 4.

Squirrel-Cage Armature.—K. H. Haga and J. A. Schouten.—The authors show how the distribution of the current in a squirrel-cage armature can be determined in a very simple way from the vector diagram of the currents for a polyphase system.—*Elek. Zeit.*, July 9.

Lamps and Lighting.

Lighting.—A review of recent progress in electric lighting in Germany. The development of arc lamps with impregnated carbons is first discussed, and it is said that Beck's gravity-fed lamp without any special feeding mechanism led to many similar constructions. The longest life of carbons which can be obtained with such lamps is about 16 to 18 hours for impregnated carbons of 600 mm length. To lengthen the life English firms have introduced "magazine lamps" with a number of pairs of carbons which, however, involve necessary complications in construction. The quartz lamp (mercury-vapor lamp in a quartz globe) represents an improvement over the ordinary mercury-vapor lamp, since when used at 220 volts it gives a considerably better spectrum. The quartz lamp competes with arc lamps of high candle-power. It has the advantages of low specific consumption of power per candle-power and very long life and requires no attendance whatever. But the first cost is high and the color of the light is not yet ideal. The lamp is already being used to a considerable extent in Germany. The most important progress in arc lamps is stated to be the construction of flame-arc lamps with carbons vertically above each other; in these lamps the carbons have a longer life than in flame-arc lamps with the carbons arranged side by side. The feature of these lamps is the composition of the carbon as patented by Blondel; the impregnated core of the carbon fills about five-sixths of the total diameter. These new flame-arc lamps are used in sets of three in 110-volt plants and in sets of

six in 220-volt plants. The life of a carbon of 325 mm length is 24 hours. The current is 6 amp to 15 amp. The specific consumption of power, including the series resistance, is 0.28 to 01.8 watt per mean lower hemispherical hefner candle-power. The carbons are made for white and for yellow light. These lamps were first introduced in France, but are now also made in Germany and it is thought that they will be very useful in competition with gas lighting. The metallic-filament lamps are very widely used now. "Where in 110-volt plants to-day carbon-filament lamps of 25 cp or more, consuming 3 to 3.5 watts per hefner cp, are still used, an absolute ignorance of engineering progress can always be established." All lamp factories are now making tungsten lamps and several new factories have been started. "In a short time the market will be crowded with 110-volt metallic-filament lamps to such an extent that the price, which is still high, though not prohibitive, amounting to 75 cents per lamp, will be reduced; this will be neither to the disadvantage of the makers nor to that of the consumers." For 100 to 130 volts tungsten lamps are now made with capacities of 25, 32, 40, 50 and 100 cp. Lamps of 50 cp or more must generally be used in a vertical position, while 25-cp lamps can be placed in any position. With respect to sensitiveness against vibrations the lamps should be further improved. The lowest-capacity metallic-filament lamp is the 120-volt, 16-cp tantalum lamp, which has a life of 800 to 1000 hours. It consumes 1.5 to 1.7 watts per hefner cp, but it can be used in any position and is not sensitive to vibrations. For 200- to 220-volt plants tungsten lamps are made with 40, 50 and 100 cp, but their life is not as long as that of the 110-volt lamps.—*Elek. Zeit.*, July 16.

Nernst Lamp.—B. WALTER.—An account of an experimental investigation of the effect of a variation of voltage on the candle-power of a Nernst lamp. A set of 110-volt, 0.25-amp Nernst lamps were compared with an osram lamp, which had been previously calibrated. The results are given in the following table:

		Volt.	cp	Volt.	cp	cp loss.
Nernst lamps.	I	111.3	28.6	105.6	19.8	30.8%
	II	111.0	30.0	105.3	27.7	7.6
	III	110.8	31.0	105.6	29.1	6.5
	IV	111.5	34.5	106.2	34.5	0.0
	V	111.3	29.5	105.11	27.2	7.0
	VI	112.9	31.3	105.7	28.8	6.3
	VII	112.7	37.0	105.5	31.5	11.7
	VIII	112.0	34.3	105.1	15.0	45.7
	IX	111.5	31.5	104.8	28.2	8.7
Osram lamp		111.0	25.1	104.8	20.0	16.4

The first column gives the voltage in the first experiment which is approximately normal (110 volts), the next column gives the candle-power at this voltage. The third column gives the voltage in the second experiment, which is about 5 per cent less than normal. The fourth column gives the candle-power of the second experiment, and the fifth column gives the loss of candle-power in the second experiment as compared with the first experiment. That is, the last column gives the loss in candle-power in per cent when the voltage is decreased by 5 per cent. Only one lamp (I and VIII) showed a loss of candle-power over 30 per cent. The test VIII was made with the same lamp, but with another series resistance. The largely increased loss of the candle-power in this case emphasizes the necessity of selecting a proper series resistance for each lamp. All the other lamps show a loss of candle-power of less than 12 per cent and the lamp IV maintained its candle-power absolutely constant. This shows that there are still possibilities for development of the Nernst lamp in this respect, and it is recommended that the factories should be careful in providing the proper series resistance with each lamp.—*Elek. Zeit.*, July 16.

Power.

Steam Turbines.—W. H. EYERMANN.—The conclusion of his long illustrated article describing several types of steam turbines built in Germany and their main features. In the discussion which followed the paper, Ziehl pointed out that the speed of steam turbines is still too high for driving electric generators, especially direct-current generators. Fig. 3 shows the cost of manufacturing direct-current dynamos (as ordinate) as function of the speed (as abscissa) and of the capacity. For a given capacity, the cost becomes a minimum for a certain speed and this minimum is the lower the greater the capacity. The speed which would be most favorable is below that of steam turbines, and for this reason the construction of electric generators to be driven by steam turbines is relatively expensive. In his reply Eyermann stated that it was until recently impossible to build a 2000-kw dynamo for 3000 r.p.m. The Allg. Elek. Ges. has recently built such a machine in form of an induction generator running above synchronism. While (beyond the speed representing the minimum cost) the cost of the electric generator increases with increasing speed, the cost of the steam turbine increases with decreasing speed, and to make the total cost a minimum, a curve should be plotted giving the sum of both the cost of generator and steam turbine as functions of the speed. Companies which build both generators and steam turbines can thus select the most favorable speed for which the cost of the whole set becomes a minimum.—*Elek. Zeit.*, July 2.

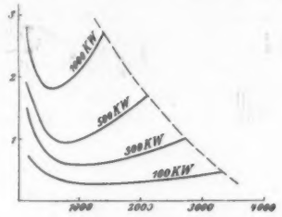


FIG. 3.—MANUFACTURING COST CURVES.

Traction.

Railway Signals.—An illustrated article on the electric signal system employed at the New Victoria Station, in London. Use is made of the Sykes electro-mechanical system, so called because the distinct operations of signal and point movement are performed, respectively, by means of electrical and manual energy. All signals are actuated electrically by "slides" in the operating frame, and the points are moved by mechanical levers which are interlocked in the ordinary way. The use of the slides saves a considerable amount of space in the frame and also labor in operation. In conjunction with this installation is the lock-and-block system, the distinctive feature of which, apart from those of signal operation, is the interlocking of the block instruments with the signal slides and point levers. The ordinary block telegraph instrument, common to most railway systems, is dispensed with, and its place is taken by indicating and locking devices which prevent the release of sectional signals in one box without what may be called "electrical permission" from the signalmen in other boxes. The connections are, in fact, so arranged that each signalman has electrical control of the release of the signals on each side of him, and unless he closes the releasing circuit of the particular signals controlled they cannot be pulled off by the man in the next box. The act of giving the release signal, or "plunging," as it is termed, locks the push switch by which the signal has just been sent, and prevents the signalman sending forward another train until the preceding one has passed over a "treadle" or rail switch, which again releases the plunger of that particular section.—Lond. *Elec.*, July 17.

Single-Phase Traction.—P. DAWSON.—In a continuation of his very long serial on electric traction on railways, the author discusses the rating of direct-current and alternating-current traction motors. He first gives in a table a comparison between the one-hour rating and the continuous rating of direct-current traction motors, from which it is seen that for large railway motors the hour-rating is from 2 1/3 to three times the continuous rating. He then compares the hour and continuous rating for single-phase motors and shows that the hour rating is only 1½ to three times the continuous capacity. In the design of larger single-phase traction motors artificial or forced ventilation has come into use to a considerable extent.—Lond. *Elec.*, July 17.

Single-Phase Traction at Hamburg.—A note on troubles experienced on the single-phase road from Blankenese to Ohlsdorf. The railway generators were recently damaged. While this has now been remedied, it will not be possible to resume the full

electric service again on July 1, since there have recently been many short-circuits of high-tension insulators which have caused considerable trouble. It is thought that this was caused by the smoke of the steam locomotives. The insulation of the overhead line will, therefore, be strengthened and the full electric operation will not be taken up again before Oct. 1.—*Elek. Zeit.*, July 16.

Single-Phase Locomotive.—S. C. Dewitt.—An illustrated description of the single-phase locomotive built to haul freight or passenger trains on the Windsor, Essex & Lake Shore Rapid Railroad of Canada.—*Elec. Railway Jour.*, July 25.

Rail Joints.—A. H. Gibbings.—A paper read before the Tramways and Light Railways Association. The author describes some of the modern forms of rail joints for tramway track and the methods which have been adopted to make the joints as nearly as possible like the rest of the rail as regards running. The author deals with fish plates, sole plates, welded plates, anchors, combinations, forged rail ends, adjustable joints and bonding. His chief conclusion is that theoretical calculation shows, and practical experience proves, that the usual type of fishplate is unsatisfactory. Attempts have been made to get over this defect in design by making them longer. One engineer suggests 3 ft. The trouble is not overcome by that means, but by limiting their function to supporting the rails laterally.—Lond. *Elec.*, July 17.

Tramways.—C. Robinson.—A paper read before the Tramways and Light Railways Association giving a historical sketch of the development of the tramway systems in different countries, and especially in London. As regards engineering improvements, the greatest advance of recent years is said to be in track construction, and as a good example of modern practice the permanent-way construction on the London United Tramways is described.—Lond. *Elec.*, July 17.

Tramway System.—An illustrated description of the recent track reconstruction and extensions undertaken by the Western New York & Pennsylvania Traction Company. There is a single generating station from which three-phase currents at 19,000 volts are transmitted to four converter substations.—*Elec. Railway Jour.*, July 25.

Surface-Contact System.—Illustrated notes on the use of the Dolter surface-contact system on roads of 27 miles length in Torquay, Mexborough and Hastings, in England.—*Elek. Zeit.*, July 9.

Installations, Systems and Appliances.

Excessive Pressure Analogies.—I. Doery.—A mathematical paper presented at the recent convention of the German Association of Electrical Engineers on the analogies between excessive voltage produced in transmission lines at the moment of switching, etc., and the excessive pressures produced in hydraulic pipes by sudden changes of the load of the turbine. The author discusses especially the maximum pressure which is produced in a pipe with running water when the outflow is suddenly closed. It is shown that there is a complete analogy between the electric and hydraulic conditions, and that Kennelly's formula for the electric conditions may be applied directly to calculate the excessive pressure in the pipe leading to a turbine. This pressure is proportional to the speed of the running water and the square of the difference in level.—*Elek. Zeit.*, July 16.

Excessive Voltages.—C. Feldmann.—The conclusion of his very long paper on excessive voltages in transmission lines, their cause, their effect and remedies. The concluding instalments give a review of the different protective devices used against excessive voltages and deal with the troubles experienced when an earth develops in one phase.—*Elek. Zeit.*, July 16.

Electrophysics and Magnetism.

Metallic Alloys for Electrical Purposes.—W. Guertler.—On the basis of our present knowledge of the properties of metallic alloys the author discusses the possibilities of finding new alloys with useful properties in engineering. The first problem is to find a new good conductor which would have a conductivity approximately equal to that of copper, silver or gold. The gist of the author's argument is that it will be fruitless to look for a new conductor with such properties either under metallic compounds or alloys. The only problem which would not be hopeless would be to make such additions to a conductor which while diminishing the conductivity only a slight degree would greatly improve the chemical and mechanical properties. Another important problem is to find an alloy with a very low temperature coefficient of resistance for resistance wires. The author concludes that the chief constituent of such an alloy must be in practice either iron or nickel or copper, or for special purposes silver or gold or platinum. But there are possibilities in trying all kinds of additions, either of metals or metalloids, with the above chief constituents. There is still a large field for investigation.—*Metallurgie*, May 22.

Positive Electrons.—J. Becquerel.—An account of experiments in which the author succeeded in producing a flux of positive electricity, able to be deflected magnetically like cathode rays. The author concludes that the beam is formed of positive electrons.—*Comptes Rendus*, June 22; Lond. *Elec.*, July 17.

Electrochemistry and Batteries.

Electric Smelting of Iron and Steel.—E. Stassano.—A fully illustrated description of the system of the author, who is a pioneer in the field of reducing iron from ore and refining steel in the electric furnace. His process is in use in the artillery works of the Italian government in Turin and at the Stassano Steel Works in the same city, which are interesting as they are the only steel works in the world exclusively operated by electricity and in which the whole output is obtained by electric furnaces. The process is also used in a special steel works in Germany. Various forms of stationary and rotary furnaces are described and illustrated. The author emphasizes that he has solved the problem of obtaining refined steel in an electric furnace in one operation directly from ore mixed in the right proportion with carbon as a reducing agent and suitable fluxes. The method of reducing iron ore in the electric furnace is applicable in countries where water power is abundant and coal is expensive. On the other hand, the furnace is also applicable directly to steel refining in connection with ordinary metallurgical works. The author emphasizes that since the atmosphere in his furnace is chemically neutral the metal may be entirely freed from all impurities without the risk of pernicious oxidation. A number of interesting tables give results obtained in practice in the production of steel from ore, the manufacture of ferro-alloys and the refining of steel in commercial practice with his furnace.—*Electrochem. and Met. Ind.*, August.

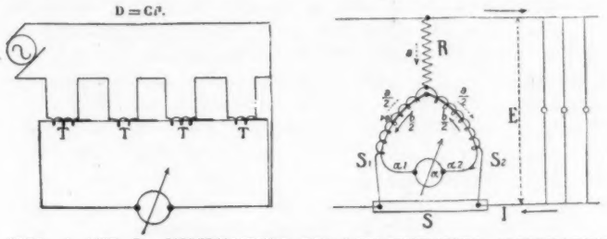
Charging Batteries.—R. Edler.—The author discusses methods of charging a storage battery without the use of a booster from the supply mains by dividing it into three groups. Two such methods may be used. If the three groups are called 1, 2, 3, then the first method consists in first charging 1, 2 and then 1, 3 and finally 2, 3. We have, therefore, three charging operations, each of two groups in series. The second method consists in first connecting 1 and 2 in parallel and both in series with 3. Charging is carried out until 3 is fully charged, while 1 and 2 are only half charged. Three is then disconnected and 1 and 2 connected in series, obtaining the full charge. The author describes how this latter method may be carried out with the aid of only two switches, diagrams of the connections being given.—*Elek. u. Masch.*, June 28.

Electric Furnaces.—L. D. Farnsworth.—An illustrated account of experimental work done by the author at Stanford University, with special reference to steel smelting in the electric furnace. A furnace for determining resistance is also described.—*Electrochem. and Met. Ind.*, August.

Units, Measurements and Instruments.

Instruments for Alternating Currents of Low Intensity.—L. Pillier.—A description of instruments for use with alternating currents of the order of magnitude of one milliampere. The current to be measured passes through a coil of very fine wire of high electric resistivity. A thermocouple is placed in the center of the coil and is connected to a moving-coil galvanometer. In order to make the arrangement more sensitive, a number of such coils T are connected in series. In the center of each

coil a thermocouple is placed and all the thermocouples are in series with each other and with the galvanometer, as shown in Fig. 4. With proper arrangement the deviation of the galvanometer is proportional to the square of the current. To measure a small alternating-current power, the arrangement of Fig. 5 is used. There are two coils, S_1 and S_2, in series and



FIGS. 4 AND 5.—INSTRUMENTS FOR LOW-INTENSITY ALTERNATING CURRENTS.

their ends are connected to a resistance S inserted within the circuit. The common joint of the two coils is connected by the resistance R to the return circuit. The current a in R is dividing into two halves passing through the two coils S_1 and S_2. There also passes through the two coils in series a current $b/2$ from one end of the resistance S to the other end. The current in S_1 is therefore $\frac{1}{2}(a+b)$ and the current in S_2 is $\frac{1}{2}(a-b)$. The thermocouples in the center of the two coils are in series, but opposed to each other, and are connected to the galvanometer. It can then be easily shown that the deflection of the galvanometer needle is proportional to $a\ b$ in any moment. From this it follows that for alternating currents the deflection is proportional to the power to be measured.—*La Lumière Elec.*, June 27; *L'Industrie Elec.*, July 10.

Moving-Coil Instruments.—O. HERAIN.—In moving-coil instruments the occurrence of pivot friction is often observed; the needle does not assume at once the proper position, but is arrested before or behind the proper point. It only assumes the correct position when by knocking on the table the instrument is set into slight vibrations. The lighter the moving-coil system and the stronger the springs employed, the less is the liability of point friction manifesting itself. The ratio of the weight of the moving-coil to the force of the springs indicates therefor the quality of an instrument. The author discusses mathematically what form of the moving system will give a maximum momentum. The best form is found to be the circle, while of rectangular forms the square is the best. By increasing all dimensions of the frame, the ratio of force of spring to weight of moving system, as well as the damping effect, are improved. The damping effect is influenced especially favorably by increasing the dimensions in the direction of the axle of rotation.—*Elek. Zeit.*, July 9.

Integrating Photometer.—H. KRUESS.—A description of a modification of the Matthews indicating photometer (ELEC. WORLD, Jan. 21, 1905). A series of mirrors is used as in Matthews' instrument, as shown in Fig. 6, where S is a circle containing 18 mirrors, while the source of line L is in the center of the circle. The different mirrors of S reflect the light of L onto a number of lenses O (Fig. 7). There are as many lenses as mirrors. These lenses concentrate pictures of the lamp L on the frosted glass M. All these pictures are superposed on each other so that the resulting picture represents the sum of the light radiations in the different directions. Before each lens O there is a slit b, and the opening of each slit is made proportional to the cosine of the angle corresponding to the mirror which belongs to the slit in question. In this way the brightness of each picture is made proportional to the cosine of that angle so that the sum of all pictures gives the correct integral as is understood from Matthews' photometer.—*Jour. f. Gasbel*, July 4.

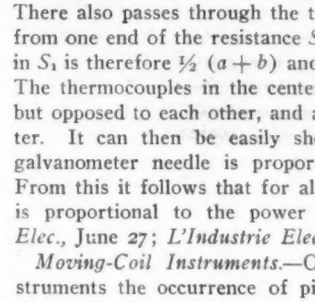


FIG. 6.—INTEGRATING PHOTOMETER.

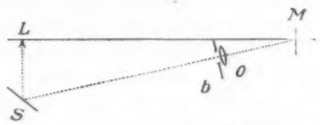


FIG. 7.—MIRROR AND LENS SYSTEM.

Measuring the Speed of Steam.—VON LOSSAU.—An illustrated paper read before the Karlsruhe Electrical Society. The speed of steam is measured by passing it through a tube, the cross-section of which is reduced at one place so as to produce a difference of pressure of the steam before and after this point. From this difference of pressure the speed of the steam may be found. An electric device is described by means of which the instrument is made recording.—*Elek. Zeit.*, July 2.

Telegraphy, Telephony and Signals.

Generator for High-Frequency Oscillations.—R. A. FESSENDEN.—An illustrated article in which the author describes a high-frequency alternator driven by a small steam turbine for use in wireless telegraphy. A frequency of 250,000 was originally intended, but 90,000 was finally adopted as being more suitable for work during daylight. The output of the machine is about 2½ kw at 75,000 cycles. This machine is of the double-armature type, there being 300 coils on each armature and the field having 150 teeth. The two field-gaps are approximately 1/16 in. in length. For speed regulation it has been found impossible to depend upon speed regulators of the usual type, and the author's resonance speed indicator is used ("Frequency Meters," ELECTRICAL WORLD, Nov. 11, 1899). The method employed is to attach a circuit to the antenna, as shown in Fig. 8, containing a dynamometer with two contacts. This circuit is tuned to about one-twentieth of 1 per cent higher than the desired frequency. These contacts govern an electrically-controlled throttle valve in series with a sensitive reducing valve in such a way that if the frequency increases one-twentieth of 1 per cent the needle touches the upper contact and cuts down the speed. If the frequency falls one-twentieth of 1 per cent the needle falls and increases the steam admission. By using a large amount of inductance in the circuit and air condensers, and using a low resistance dynamometer, the speed can be kept constant to approximately one-fiftieth of 1 per cent if desired, which result is much better than can be obtained with any mechanical speed indicator.—Lond. *Elec.*, July 3.

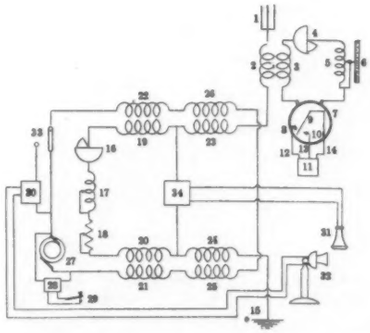


FIG. 8.—DIAGRAM OF HIGH-FREQUENCY GENERATING SYSTEM.

Municipal Electrical Association.—An account of the recent convention of the (Brit.) Municipal Electrical Association. In his presidential address H. Talbot referred to the continuous increase in the use of metallic-filament lamps. While this necessarily causes, first, a considerable reduction in the revenue of the station, it must finally be beneficent. He considered the maximum-demand system the fairest and most equitable method of charging which has been devised up to the present. Reference was made to the intention of the city of Birmingham to introduce registration of wiring contractors who are authorized to carry out installations in that city. The question of the use of town refuse as fuel for the generating station was touched upon. "Looked at from the broadest standpoint of the ratepayer the combination is, perhaps, desirable, as the refuse must be destroyed, and that as effectually and as cheaply as possible. It is a certain fact, notwithstanding, that the handling and burning of the refuse alone costs more than the same output could be obtained for at the coal-fired generating station." B. Wightman's paper on the experiences of a convenor elicited considerable discussion and speakers were unanimous that the chairmen of the electricity committees should not intervene in technical matters at all, but should leave these entirely to their engineers. Abstracts of technical papers presented at the meeting will be found elsewhere in the Digest.—Lond. *Electrician, Elec. Rev., Elec. Eng.,* July 3, 10; *Elec. Eng'ing,* July 2, 9.

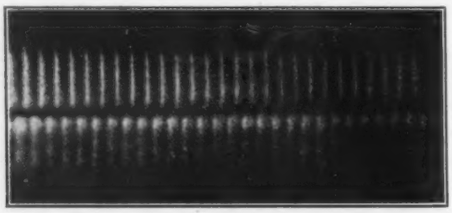


FIG. 9.—REPRODUCTION FROM PHOTOGRAPH OF UNDAMPED OSCILLATION.

Measurement of Electric Oscillations.—Diesselhorst.—An illustrated paper read before the Berlin Electrical Society on some work carried out in the Reichsanstalt in the interest of wireless telegraphy. There are now in the market quite a number of wave meters. To give fully satisfactory service they must be calibrated according to an absolute scale. The Reichsanstalt has found it advisable to carry out the calibration by means of a set of standard instruments for which the commercial condensers with variable capacity could be used directly, while the inductance coils were especially designed and constructed. Three methods have been used to calibrate these standard instruments. The first method is based on measuring the wave length on the Lecher wire system. In the second method the period is calculated from self-inductance and capacity by means of Thomson's formula. The third is Feddersen's method of photographing the discharge spark by means of revolving mirrors. The last two methods are especially suitable for long waves, the first for short waves. All three methods were used and the results obtained by the last two methods agree exceedingly well with each other; especially for long waves, above 1000 m, the results agree by about 0.1 per cent. On the other hand, the wave lengths found by Lecher's method are too short, especially for long waves. This is caused by the resistance of the wire. The author finally discusses the use of Gehrcke's luminiscent tube method for analyzing quick oscillations. Several pictures obtained by this method are reproduced. Some of them show clearly the difference between primary and secondary oscillations. Fig. 9 is the picture of an undamped oscillation obtained by Poulsen's method, using an arc in an hydrogen atmosphere.—*Elek. Zeit.,* July 16.

Influence of Terminal Apparatus on Telephone Transmission.—L. Cohen.—An Am. Phys. Soc'y paper in which the author determines mathematically the effect of inserting a receiver at the end of a transmission line. The effect in a short line (30 km) and in a long line (300 km) are calculated. For the short line it is found that the receiver in the circuit increases the distortion, but that the introduction of a condenser will improve the transmission. While telephoning at such a short distance as 30 km is possible with almost any apparatus, yet there is still considerable room for improvement and it would seem that the introduction of a condenser of the proper magnitude in series with the receiver ought to produce good results. In the case of a long line (300 km) the introduction of the telephone receiver does not materially influence telephonic transmission.—*Phys. Rev.,* June.

Duplex Telegraphy.—Henry.—An illustrated description of an arrangement by which two telegraph stations can communicate simultaneously and independently with two other stations over the same line with the use of ordinary telegraph apparatus. —*L'Ind. Elec.,* July 25.

Multiplex Telegraphy.—H. C. Magunna.—The first part of a long illustrated article on the application of harmonic pulsating currents to printing telegraph systems and on the multiplex telegraph system of E. Mercadier.—*La Lumière Elec.,* June 27 and July 11.

Miscellaneous.

European Electrical Industry.—An article giving notes on the present financial and trade conditions in the manufacture of cables in continental Europe.—Lond. *Elec. Rev.,* June 12.

Steam Condensers.—A review of the general lines along which condenser construction in central stations has developed in recent years, especially in connection with the progress of the steam turbine. The preference of the equipment of steam turbine stations with surface condensers and the use of rotary pumps are discussed.—*Elek. Zeit.,* June 4.

NEW APPARATUS AND APPLIANCES

Some Interesting Machines for the British War Department.

The Siemens Brothers Dynamo Works, Limited, give particulars of some interesting machines recently supplied to the British War Department. Fig. 1 shows one of two large generators which are of special interest as being among the largest machines yet built in Great Britain with commutation poles. They will be driven by triple-expansion, vertical-type steam engines built by Messrs. Yates & Thom. The armatures are directly bolted to the engine flywheel.

There are 14 shunt-wound main poles, and an equal number of commutation poles. Each machine is designed to give 2900 amp continuously at from 500 to 530 volts as a shunt generator when driven at 85 r.p.m., the specified temperature rise of the hottest part after 12 hours run on full load being not more than 70 deg. Fahr. and the efficiency not less than 93 per cent, measured by the Hopkinson test. The specified overload capacity is 25 per cent for two hours.

The yoke is of cast steel and the main poles are laminated throughout; both the latter and the commutation poles can be removed without dismantling the machine. The armature is of the slotted drum type and is built up of soft iron laminations. It is mounted on a cast-iron spider, and is well provided with ventilating ducts. Form-wound and interchangeable armature

coils are employed, and are kept in place in the slots by wooden wedges through the whole of their length, the end connections being secured against displacement by centrifugal force by a special steel binding ring, easily removable.

The insulation of the coils consists of layers of mica and pressphan, which are held together with shellac and molded

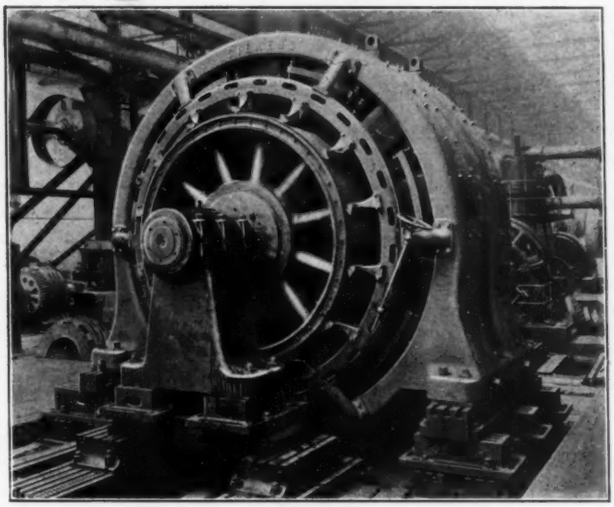


FIG. 1.—ONE OF THE GENERATORS.

while hot over the group of conductors, previously taped. An extra thickness of insulation is provided between the top and bottom members of two coils in a slot. A suitable number of equalizing rings of large section are provided.

The commutator is of hard-drawn, high-conductivity copper, and is insulated with mica. Each segment was carefully milled to the correct taper before being built in, and the whole subjected to a heavy pressure before being machined. The brushes are of carbon, the current density at full load being about 30 amp per square inch.

Before leaving the works, the machines were subjected to severe tests and gave the following results:

For the 12-hour, full-load run at 530 volts, 2900 amp, the machines were coupled up in the usual way, the losses being supplied electrically and the field coils excited from an external source. The run was made with the generator giving the full

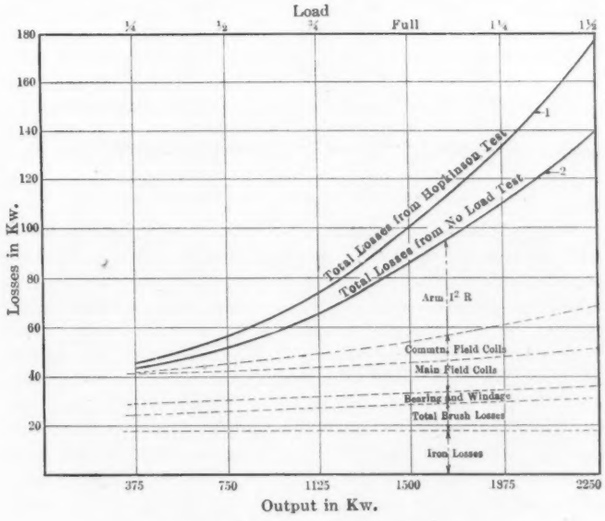


FIG. 2.—CURVES OF LOSSES.

rated output of 1500 kw, corresponding to about 14 per cent overload on the motor. At the end of 12-hours' continuous run at this output, the following temperature rises were observed:

	Rise in deg. C. above surrounding air. Generator.	Motor.
Armature core	29 deg. C.	29.0 deg. C.
Armature end connections	23 deg. C.	24.0 deg. C.
Commutator	21 deg. C.	18.0 deg. C.
Shunt coils	31 deg. C.	24.5 deg. C.
Commutation coils	28 deg. C.	32.5 deg. C.

The commutation was sparkless throughout.

In the efficiency test the machines were coupled up as before, and the following results were obtained:

	Generator		Motor			Amps.		Efficiency of each
Speed.	Gen. amps.	Field amps.	Motor amps.	Field amps.	Volts common to both	supplied externally.	Mean load kw.	machine on mean load.
85.2..	740	23.9	842	21.9	532	127	420	90.2%
85.0..	1,450	24.8	1,595	20.8	528	172	805	93.4%
85.0..	2,250	27.3	2,560	21.9	530	266	1,272	94.0%
85.0..	2,970	29.1	3,360	22.8	530	380	1,675	93.8%
85.0..	3,700	31.1	4,220	24.0	529	536	2,095	93.3%
85.3..	4,500	33.4	5,320	24.9	529	767	2,570	92.2%

It will be noticed that the efficiency remained high also at light loads. The maximum motor current of 5320 amp corre-

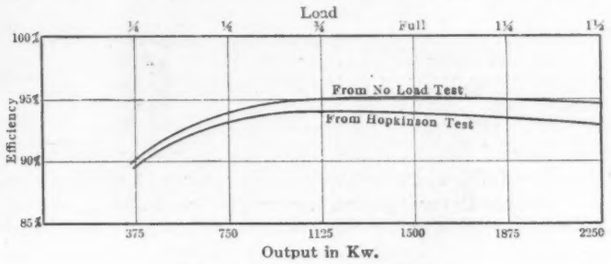


FIG. 3.—EFFICIENCY CURVES.

sponds to an overload of 84 per cent, and there was only a trace of sparking. In all the other cases the commutation was sparkless.

A third test of 10 hours' duration was also carried out to determine the temperature rises on overload, the following results being obtained:

Generator current = 3,500 amp.
Motor current = 4,000 amp.

	Temperature rise. Generator.	Motor.
Armature core	36.5 deg. C.	32.5 deg. C.
Commutator	21.5 deg. C.	32.0 deg. C.
Shunt coils	37.0 deg. C.	29.5 deg. C.
Commutation coils	41.5 deg. C.	57.0 deg. C.

Thus, on an overload of 39 per cent on the motor for 10 hours, the only parts with a temperature rise higher than speci-

FIG. 4.—VARIABLE SPEED MOTOR.

fied for the normal load of 2900 amp were the commutation poles.

The reason for the lower temperature rises on the motor is due to the fact that the cool air was delivered to the motor

side of the combination, and the generator had the disadvantage of receiving air which had already passed the motor. In calculating the temperature rise, the mean air temperature was taken, and this of course handicapped the generator. The commutation was said to be perfect throughout the test.

It is well known that the sum of the no-load losses plus the additional I^2R losses due to the load do not make up the total power lost at full load, but the extent of this discrepancy is not generally recognized, and has led to much doubtful practice in specifying efficiencies. The serious nature of this error is well illustrated in Fig. 2, in which the upper curve represents the total losses as given by the Hopkinson test, and the lower curve the total losses as obtained from a no-load test. In curve 1, Fig. 2, half the losses supplied from external sources are plotted against the mean load of the coupled machine as found from the Hopkinson test. The discrepancy in the efficiency as obtained by these two methods is considerable, as may be gathered from Fig. 3 and the following table:

Load.	Efficiency by Hopkinson test.	Efficiency by no-load test.	Guaranteed efficiency.
Fifty per cent overload.....	93.0%	94.5%	..
Full load.....	94.0%	95.0%	93%
Three-quarters load.....	94.0%	94.8%	..
One-half load.....	93.0%	93.8%	..
One-quarter load.....	89.5%	90.2%	..

In view of the fact that machines are sometimes required to give their full-load current with a very weak field (for instance, for Siemens-Ilgner flywheel converters for colliery winding, where a current considerably in excess of full-load current may be required at practically zero volts), it was decided to test

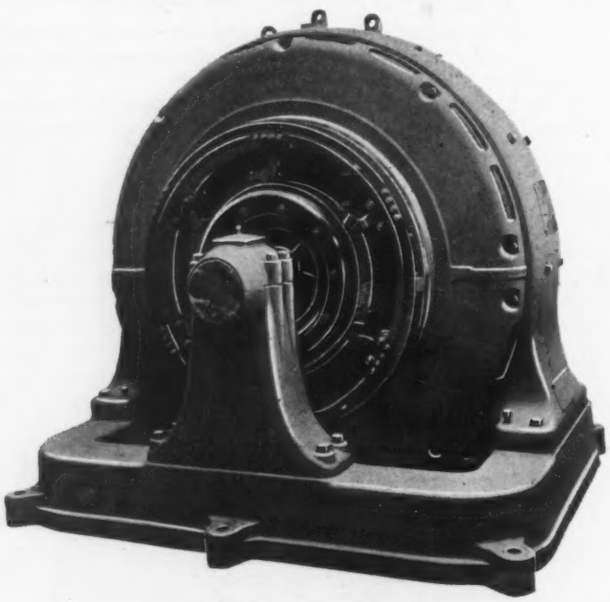


FIG. 5.—COMMUTATOR END OF VARIABLE SPEED MOTOR.

these machines also in this direction. The test was a short-circuit test, and it was observed that about 2 per cent of the normal shunt current was required to produce full-load armature current, and about 3 per cent for 50 per cent overload. With the very weak fields thus produced, a current of 4500 amp was taken from each machine in turn, and the commutation was quite sparkless with fixed position of brushes. This current corresponds to an overload of 55 per cent.

Another machine supplied to the British War Department, interesting on account of the fact that it is one of the largest, if not the largest motor, yet made with as wide a speed variation as 1:6, is shown in Figs. 4 and 5.

It is designed to give 100 brake hp at a pressure of 500 volts, the speed ranging between 100 and 600 r.p.m. There are six main poles and an equal number of commutation poles. As will be gathered from the illustrations, the motor is of the ventilated type, the openings being covered with gauze. The speed variation is obtained by shunt control, and on test the motor was stable and ran sparklessly under all working conditions—from no load to 100 per cent overload at all speeds. Sparking could not be detected even when the brushes were tilted on to their sparking edge. After a 5-hour run at full load and 350 r.p.m.—the mean speed of the motor—the temperature rise nowhere exceeded 37 deg. Fahr., and after 6 hours full load run at the highest and lowest speeds, the temperature rises were quite within normal limits.

The efficiency of the machine at full load is 88 per cent from 200 to 400 r.p.m., being slightly lower at the extreme speeds.

National Electric Lamp Association

The members of the National Electric Lamp Association are placing upon the market four new types of lamps. Two of these are Gem lamps with oval filaments, all Gem lamps of the same voltages having been heretofore made with two-loop filaments only. Two of these are tungsten "Meridian" type lamps in the regular round "Meridian" type bulbs of 3¾ in. and 5 in. diameters. The detailed description follows:

The existing Gem-filament type lamps 90 to 130 volts are all made in the double-loop type. The difficulty in properly metalizing filaments of other forms and types has been now overcome in the oval type which is being employed in the two new Gem lamps now ready for the market.

Gem lamps, voltages 90—30, have been made heretofore in the 50—100—125—187 and 250-watt sizes. The two new types are supplementary to the above, are of 40 and 80-watt sizes and are designed for the same voltages, namely 90—130, as the present Gem lamps. The mean horizontal candle-power of the 40-watt lamp is therefore 16 candles and of the 80-watt lamp, 32 candles at 2½ watts per mean horizontal candle. These two lamps are made in bulbs which are standard in the carbon-filament sizes for 16 and 32 cp respectively. The 16-cp bulb (the "SS-19") is standard in the Gem 50-watt size; consequently, the 40-watt lamp in this size bulb is similar to the Gem 50-watt, although dissimilar in the type of filament.

The Gem 80-watt lamp, designed to operate at 32 candles at 2.5 watts per candle, is made in the bulb (the "SS 24" bulb), which is standard in the 32-cp carbon type of lamp and therefore, so far as cursory inspection goes, this lamp is exactly similar in appearance to the 32-cp carbon lamp which it is intended to displace. Cuts of these two lamps (with the ordinary small standard Edison base) appear herewith.

The tungsten "Meridian" lamps, cuts of which are also shown herewith, differ from the other tungsten-filament lamps which the members of the National Association have been putting out for these voltages (100—125), in that five filaments are employed instead of four, and in the size and shape of the bulb. Every change in size and shape of the bulb involves new problems in exhaustion and means new apparatus and equipment.

The history of the tungsten development in this country has been extremely rapid and the production facilities of the association members have been taxed to supply the demand. The supply, however, of the larger bulb lamps is now equal to the demand.

The "Meridian" type lamps were first placed upon the market with carbon filaments and gave 16 and 32 candles mean horizontal (unfrosted) at 60 and 120 watts, respectively. With the advent of the Gem filament, these same lamps were put upon the market at 50 and 100 watts with an increase in candles (mean horizontal candle-power, unfrosted) to 20 and 40 candles respectively. It will be noted that these new tungsten lamps give higher candles than any of the preceding types, in the same size of bulb, namely 32 and 48 respectively (mean horizontal candle-power, clear bulb). These lamps operate at the same filament temperature that has been adopted for the other types of tungsten lamps, namely, that corresponding to 1.25 watts per candle, horizontally.

The tungsten "meridian" lamps can be operated at any angle and are designed to give the proper distribution of light curves with the present "Meridian" or prismo type of reflectors, and involve no additional fittings, in the way of sockets, shade holders, etc., or reflectors; they are made in all voltages from 100 to 125, exactly as are other tungsten filament lamps.

FIG. 1.—40-WATT TUNGSTEN MERIDIAN.

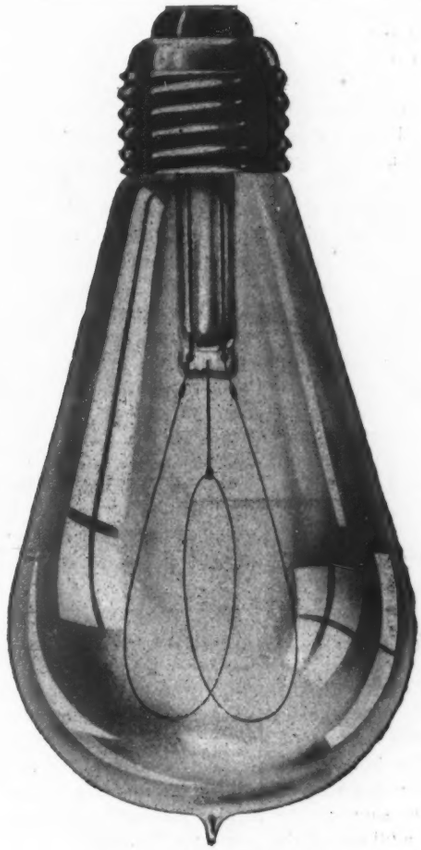


FIG. 3.—40-WATT GEM.

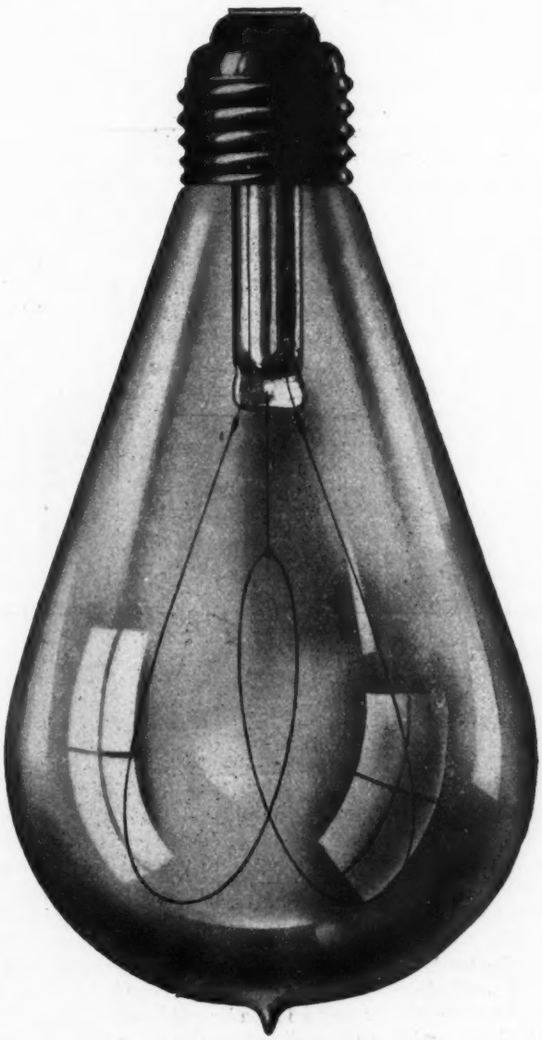


FIG. 2.—80-WATT GEM.

FIG. 4.—60-WATT TUNGSTEN MERIDIAN.

NEW TYPES OF INCANDESCENT LAMPS.

Raw Material in Electrical Construction.

The importance of employing high-grade raw material in electrical construction cannot readily be overestimated. Upon the quality and price of raw material often depends the success or failure of an engineering undertaking. At no time within recent years has the condition of the raw material and money markets been more favorable to the success of engineering work than at present. With the enforced idleness of much money and the accumulation of a surplus of raw material, undertakings can be financed with little difficulty while the cost of material is very low. For example, many electrical developments that were halted by reason of the high price of copper which prevailed last year can now be carried forward with every assurance of success with copper at considerably less than one-half of its former price. Moreover, the low price of copper now prevailing will permit of the construction of machines containing a relatively large proportion of copper which were considered commercially impracticable in the past. In order to insure reliable equipments it is necessary for the manufacturer and constructor to employ reliable raw material. A line of raw material which experience has shown to be reliable in all respects is the "Star Brand" copper, which has been placed upon the market by the U. T. Hungerford Brass & Copper Company, 497 Pearl Street, New York.

Horn Gap Lightning Arrester.

The Lord Electric Company, of New York and Boston, has brought out a new type of horn-gap lightning arrester which embodies many features of interest. The arrester is illustrated herewith. This horn-gap attachment is supplied for arresters of various types above 1000 volts. The internal construction of the arrester is the same as the regular standard type of Shaw arrester. The addition of the horn-gap, however, is a very valuable feature. There are occasions when arresters are placed on circuits of a certain voltage and after having been installed the tension of the circuit is changed. In each case the arrester would have to be replaced with a new one or one made for the higher voltage. With this type of arrester, however, the horn-gap arrester makes possible readjustment within a certain range. Further, with this attachment it is possible to use an arrester originally adjusted for lower tension on a circuit of higher tension.

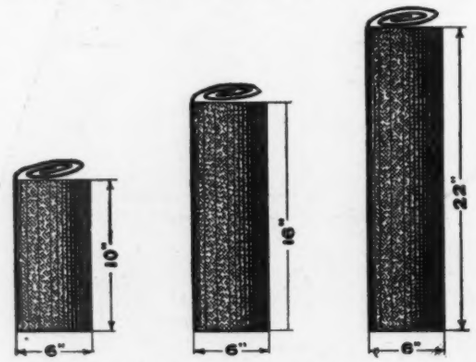
HORN GAP LIGHTNING ARRESTER.

It is also possible with this arrester to get results on circuits of widely varying tensions, whereas an arrester with a fixed air-gap equivalent would break over at a certain voltage, and if a higher tension were maintained than that for which it had been made, it might be incapable of resisting the formation of an arc. But with the horn-gap attachment an arrester with a certain spark-gap equivalent can be employed on a circuit of higher voltage than that for which the arrester without the horn-gap could be used. Especially on alternating-current circuits and series arc-light circuits is a device of this character desirable, as frequent momentary rises in tension occur which would break over the arrester, though it might be satisfactory for maximum voltage under which the circuit would be normally operated. The horn-gap attachment to the arrester, therefore, in case of closing over the circuit by excessive rise in tension, breaks any arc that may be established without destruction to the apparatus so long as it is used on circuits, the voltage of which is within its range. It also permits of a finer adjustment than might ordinarily be secured because of the ability of the horn-gap in conjunction with the standard arrester either to resist or break any arc that might be established without in anywise injuring the apparatus. This device can be applied to any number of poles and is perfectly feasible when applied to single-pole instruments.

Another form of using this type of arrester is by placing two units which would be equivalent when placed in series with each other to one instrument ordinarily made to work on the same circuit without the horn-gap attachment. In each case the two instruments which would be in each of them one-half that of the regular standard instrument mounted side by side, as shown in the cut, but with the center post removed, the ground wire will be attached to the bottom of one instrument and the line wire to the opposite bottom end with the two horns brought very close to each other. Thus the discharge coming from line passing to ground would go up through one instrument, across the horn-gap and down through the other instrument to ground. There are many places where this type of arrester can be used to advantage and experience has proved that it has some very peculiar advantages for circuits of particular characteristics.

Ground Plate.

The Federal Electric Company, of Chicago, Ill., has brought out a cartridge ground plate which will doubtless be of interest to those who have wrestled with the problem of making satisfactory ground connections in either telephone, street-railway or electric-lighting work. By its use an excellent ground is said to be secured at a minimum of expense and trouble. The device is made in standard sizes with a specified area of plate and size of ground wire. The copper surface is completely covered with the proper grade of charcoal for securing the best ground. The whole is incased in a netting which holds the charcoal securely in place while handling, but breaks down when installed, allowing the earth to mix with the finely divided charcoal. The netting is meant to disintegrate rapidly as soon as the cartridge has been buried in moist earth. The heavy copper ground wire is firmly secured to the copper plate through its entire length so that there is no chance for a break or loose connection.



CARTRIDGE GROUND PLATES.

Each complete plate is put up in a cylindrical cardboard case, which is for transportation only, and is, of course, removed when the plate is buried. The hole can be made easily with a standard post-hole digger, so that the labor of installing is light. The manufacturer suggests that a piece of fiber conduit be used to protect the wire from the ground plate to a point well above the surface of the ground. A rope drain fitted on the post or wall will lead considerable rain water into this fiber conduit and so direct to the ground plate, insuring moist earth around the plate.

Illumination of a Large Office.

Office lighting is rightly regarded as one of the difficult problems of illumination. Bookkeeping requires close application and demands such constant service of the eyes that office men are notoriously sensitive to the lighting conditions. Especially is this true in a large office where many employees are grouped together. Architects are giving more and more thought to the provision of suitable day illumination, while the demand for improvement in artificial illumination is even more imperative.

The simplest and most common method of office lighting is to provide small individual units in the form of desk or drop lamps. In many cases this is the best available form of illumination, especially when the working illumination is required only at isolated points. Perhaps the most serious fault to

FIG. 1.—NATURAL ILLUMINATION.

which this method of illumination is commonly subject is the glare of the lamps themselves or of the light reflected from desks or papers.

It is not unusual on entering an office to find the fixtures draped with all kinds of shades and provided with the highest power lamps obtainable. This is an indication of unsatisfactory illumination. Unfortunately instead of improving the illumi-

FIG. 2.—ARTIFICIAL ILLUMINATION.

nation, the experiments generally result in increased glare and consequently increased eye strain.

Good modern office lighting may be produced by general illumination from larger units installed near the ceiling and so arranged as to give even illumination. Where work is sufficiently concentrated, this method of illumination is cheap to install and to operate. A fine appearing installation can be produced which will not clutter up the room and will not suggest interference on the part of the employees. In making such an installation it is advisable to use considerable care in selecting the unit so as to produce a satisfactory result. The light source should be of low intrinsic brilliancy, with a relatively large diffusing surface in order to avoid glare and dense contrasting shadows. The lamp should be economical to operate and should distribute the light so as to produce an approximately even intensity of illumination in all parts of the room.

The size of the unit should be as large as possible consistent with an even distribution. In a large room with a high ceiling a relatively large unit may be used. A number of different arc and incandescent lamp combinations are available for this class of lighting. The equipment most suitable for a particular case frequently depends upon local conditions.

A representative installation in which an excellent illumination is produced by means of the ceiling diffuser arc-lighting system is in the offices of the Stanley Works, at New Britain, Conn. This company completed a new office building in the late summer of 1907. The artificial lighting of the large general office was planned by the illuminating engineering department of the General Electric Company in co-operation with the architects and the purchasing department of the Stanley Works. The room in question has a 22-ft. stud. The working area is 82 ft. x 75 ft., and is lighted by means of 24 6-amp direct-current enclosed-arc lamps, with the recessed type of ceiling diffusers, consuming 15.8 kw. The lighting has been in service throughout the dark winter months, and has given entire satisfaction to both the company and the employees. The excellent illumination of the office, both by daylight and artificial light, is shown by the accompanying illustrations.

Loud-Speaking Telephones for Elevator Operation.

The telephone and the electric elevator are brought into most interesting relationship and combination in the immense new Singer and Bourne Building, the tip of whose tower reaches a height of no less than 612 ft. above the curb, on lower Broadway, New York City. An article descriptive of the illumination of this immense structure was published in ELECTRICAL WORLD of July 4, 1908, and we are now glad to supplement that with an account of the novel use to which the telephone is there put, it being the first instance of a complete installation of a telephone system designed specially for elevator operation.

Although the operating conditions in the building are unusual, owing to the many elevators and their exceptionally long runs, there is every reason to believe that telephone connections between the elevator starter, the car operators and the engineer in many smaller office buildings and in department stores would likewise result in increased efficiency of service and additional security to the passengers. The passenger elevator equipment comprises 15 Otis electric traction machines and one Otis electric drum machine. Of the former, nine operate cars from the ground floor or the basement to the thirteenth floor; three cars to the thirty-fifth floor; two cars to the roof or top of the forty-seventh story, and one, a car from the ground floor to the fortieth floor. The electric drum machine runs a shuttle car between the thirty-fifth and thirty-eighth floors.

The 16 elevators are grouped in three sections: nine in the Singer Building Addition or tower portion of the structure; four in the Bourne Building, and three in the Singer Building proper. Each of the 15 traction machines has a capacity of 40 hp, and the drum machine is rated at 10 hp. The express elevator cars in the tower portion of the building travel at the rate of 600 ft. per minute, and each can carry about 18 persons. With the building fairly well filled with tenants, these cars will travel about 310 miles daily and make a yearly total of of 98,270 miles. The length of the highest elevator shaft is 546 ft. 9 in. The telephone equipment, Figs. 1 and 2, installed for each of the three elevator groups enables the starters to give oral orders at any minute to the operators in the cars and to the engineer in the basement, places the operators in communication with the engineer and starters, and keeps the engineer in touch with the

starters and car operators. Connection can also be had with the watchman on the fortieth floor, the various machine rooms overhead, the elevator shafts, the machine shop, engine room and boiler room.

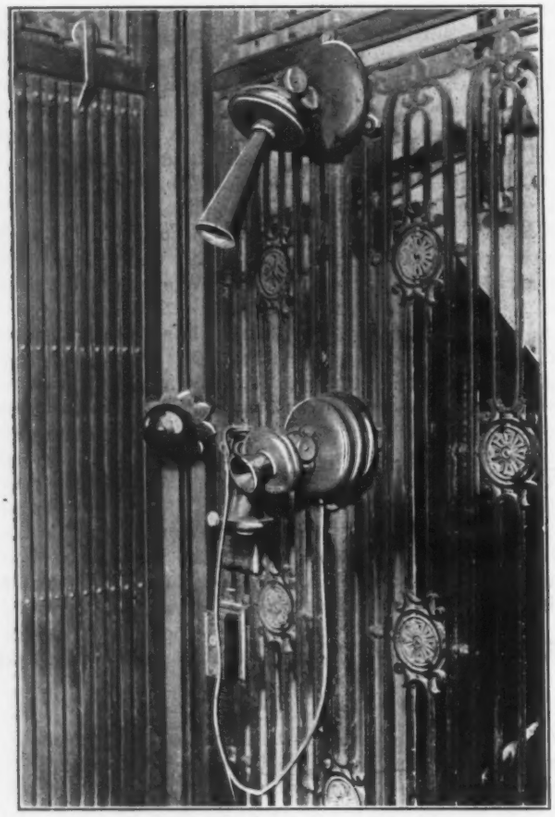


FIG. 1.—TELEPHONE EQUIPMENT ON ELEVATOR CAR.

The telephone system includes a small private exchange in the basement, supplied with current by a 24-volt storage battery, which is charged from the lighting mains. All telephone connections other than those made by the starter when he desires

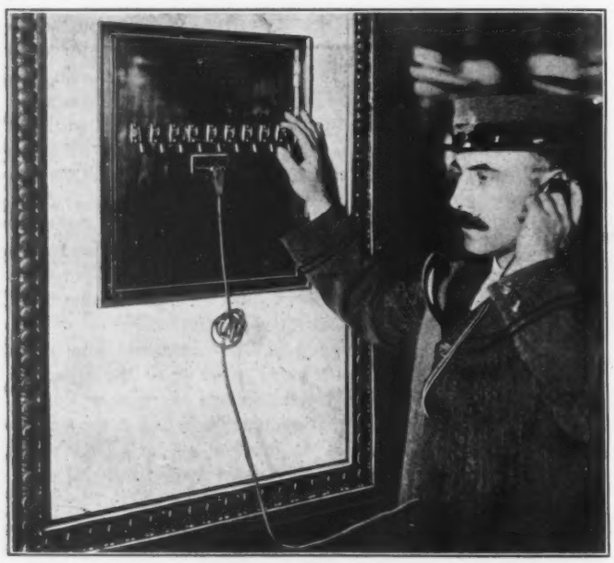


FIG. 2.—SWITCH PANEL IN HALLWAY.

to speak with the car operators under his control are made by the telephone operator at the private-exchange switchboard. This switchboard is equipped with visual signals and has a capacity of 50 line circuits and five cord circuits. Aside from the starters' and the car operators' equipments, the telephone instruments are of the familiar Western Electric type.

Each starter, while performing his duties, is within convenient reach of a small metal panel, mounted either upon the wall or upon one of the marble columns in the main hallway. Although the panel is flush with the surface of the wall or column, a call bell and a series of switches, the handles of which project through the panel for the use of the operator, are mounted behind it as illustrated in Fig. 2. The bell is for signaling the starter, and the switches enable him to connect with any one of the car operators under his charge.

The starter's telephone set, shown in Fig. 2, is of the portable type, comprising a watchcase receiver and a breast transmitter, such as is worn by telephone operators. These are connected by flexible wire cords to a twin plug, which is carried by the starter in his pocket when not in use and inserted into either one of two sets of jacks in the panel, depending upon whether he wishes to talk to the car operators or through the private exchange switchboard to the engineer or elsewhere.

The flexible connection of the starter's telephone set enables the starter while connected in circuit to face in any direction and furnish information to those inquiring about the cars or the location of the tenants, watch the electric signal lamps which indicate the position of the cars and give attention to the arrival and departure of each car under his supervision.

Loud-speaking receivers are used in the elevator cars (Fig. 1) so that the operators can hear the orders transmitted to them by the starter without placing the receivers to their ears or otherwise interfering with their work. These receivers were specially designed for use in the elevator cars, and although each contains the same elements which make up the ordinary bipolar receiver, these elements have been modified to secure an unusually loud and clear enunciation. The diaphragm has a comparatively large diameter and is held so as to be free from strain. The horn, as shown in Fig. 3, is rigidly attached to the receiver proper, but the whole is clamped to a base so that when mounted in the car it can be adjusted vertically.

In addition to the loud-talking receivers, there is in each elevator car a metal-case wall telephone set for the operator's use in securing a connection through the private-exchange switchboard in cases of emergency. The transmitter and receiver of this set may be seen in Fig. 1, fastened to the side of the car, directly below the loud-talking receiver. The ringer, condenser and induction coil of the set are mounted in a metal box which is secured to the top of the car. The entire system

FIG. 3.—LOUD-SPEAKING RECEIVER FOR USE IN ELEVATOR CARS.

and apparatus were made and installed by the Western Electric Company. Mr. J. C. Buxton, the chief engineer of the building, is of opinion that it would be impracticable to operate the elevators without such an equipment, and it would appear that an-

other large field of application has been found for the ubiquitous telephone, especially if, as seems likely, very tall buildings increase in number and become the rage.

Decorative Incandescent Lamps.

The accompanying illustrations show some artistic electrical decorations suitable for hotels, restaurants, clubs, dining rooms, banquets, social functions, etc., made by Gudeman & Gensler, of 114 East Twenty-third Street, New York City. The natural strawberry bed shown in Fig. 1 is intended for mantel or table decoration and is designed to imitate nature as closely as possible. Fruit lamps are concealed in the foliage and when lighted produce a soft and pleasing glow. The design is made in three sizes.

The miniature fruit tree which is shown in Fig. 2 is fitted with incandescent lamps with pear-shaped bulbs colored to imitate the fruit. Orange trees are made as high as 12 ft. and make artistic ornaments in stately rooms and lofty corridors. Another decorative effect consists of a hanging bell entirely covered with foliage and blossoms, containing con-

FIGS. 1 AND 2.—STRAWBERRY BED AND PEAR TREE.

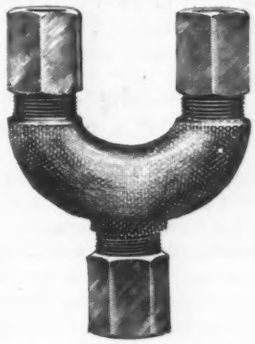
cealed colored lamps with a tongue made up of a miniature fruit lamp. The decorations on the bell may be changed to suit the occasion. The wires in all the decorations are concealed in the trunks and branches of the trees and the leaves and trunk covering are fireproof. Standard sockets are used throughout with standard fruit lamps of various sizes. The glass for these miniature lamps is blown into a mold and is colored to imitate the fruit. For floral decorations standard miniature, tipless lamps are used and the flower is worked over

FIG. 3.—PEACH TREE.

and around the lamps. The number of designs possible to make is very great and the lamps can be made for any voltage. The finished trees, etc., are fitted with cord and plug like the ordinary Christmas tree outfits.

New Solderless Connector for Cables.

The accompanying illustration shows a new Y-shaped connector brought out by Dossert & Company, of New York, for cable service. The connector was first used for joining various sets of cables running between the two switchboards of the

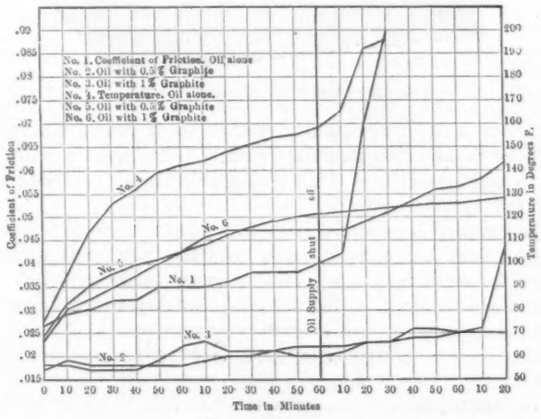


SOLDERLESS CONNECTOR.

tower of the Metropolitan Life Insurance Company's building on Madison Square, New York. Two 450,000 circ. mil cables were run in multiple in order to minimize the drop of potential and were connected to the switchboard by a single 450,000 circ. mil cable. From the engraving it will be seen that the two mains are parallel and occupy a minimum of space. This arrangement was necessary in order to have the connector take the cables as they came from the conduits. By means of the device a great saving in labor and time was effected and a compact and excellent connection also obtained.

Acheson "Oildag" Lubricant.

The accompanying curves represent the result of tests made by Prof. C. H. Benjamin, of the Case School of Applied Science, Cleveland, on the new lubricant due to Edward Goodrich Acheson, known as "Oildag," and made by the International Acheson Graphite Company, of Niagara Falls. The tests were made at a pressure of 125 lb. per square inch on a bearing running at 445 r.p.m. Spindle oil was used, first alone, then with a content of 0.5 and 1 per cent, respectively, of deflocculated graphite. The curves indicate the great decrease in friction due to the presence of the graphite. The value of the latter as a lubricant was also shown by tests with the supply shut off. In the case of oil alone the friction increased 125 per cent in 30 minutes, while there was only 14 per cent in 80 minutes in the case of the graphite lubricant.


No. 1. Coefficient of Friction. Oil alone
No. 2. Oil with 0.5% Graphite
No. 3. Oil with 1% Graphite
No. 4. Temperature. Oil alone.
No. 5. Oil with 0.5% Graphite
No. 6. Oil with 1% Graphite
Coefficient of Friction
Temperature in Degrees F.
Time in Minutes
Oil Supply shut off

"OILDAG" TESTS.

"Oildag" has pure, soft, disintegrated unctuous Acheson graphite in a deflocculated form as its basis of lubrication. It is the result of the discovery by Mr. Acheson of the process of making unctuous graphite, and his invention of the process for deflocculating it and causing it to remain suspended in mineral oil. As now made it is put up in tubes and cans containing

a charge sufficient for one, five or ten gallons of mineral oil, in which, as stated, the graphite remains suspended and is so fine that it readily passes through any kind of an oil cup, thus having ideal lubricating qualities. One of the noticeable things about this new Niagara product is its freedom from all kinds of impurities that would have a tendency to increase friction. Acheson graphite is made in an electric furnace at a temperature stated to be over 7000 deg. Fahr., which temperature vaporizes every known element except carbon, and is guaranteed at least 99 per cent pure.

Sectional Gang Conduit Boxes.

The Chicago Fuse Wire & Manufacturing Company is now placing on the market a new conduit box, No. 160, embodying the sectional gang idea already employed in its type "AA" and "BB" boxes for flexible conduit. A box for any number of gang switches can be built up from a two-gang box shown in Fig. 1 by loosening the screws and inserting spacers. The box and cover part of the spacer are formed of one piece, and the only detachable parts on top are the small end cover plates which may be removed without taking out a screw, permitting

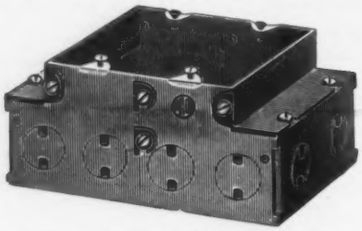


FIG. 1.—TWO-GANG CONDUIT BOX.

ready access to the bushings of the end conduits, and allowing examination of wires without disturbing switches.

Fig. 2 shows a three-gang box with the spacer in place, the hook eye construction enabling these boxes to be assembled without removing a single screw, forming a perfectly tight box, meeting in every detail the requirements of the underwriters, as well as filling a long felt want of electrical contractors for a sectional gang conduit box in which there is ample room for conduit connections, wire joints, etc. This box makes an excellent junction box when equipped with a

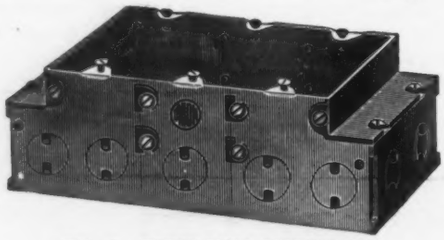


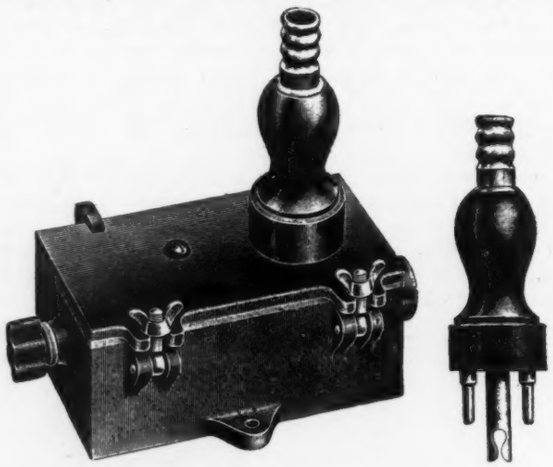
FIG. 2.—THREE-GANG CONDUIT BOX.

flat cover, and is particularly suitable as a cutout box, being designed to accommodate the single and double pole main line blocks and also several single and double branch cutouts manufactured by this company.

Each spacer is provided with two knockout plugs for ½ or ¾-in. conduit as specified, while each box portion is equipped with six such openings. The spacings between switch lug centers are standard, so that all gang switch plates fit perfectly.

Plug Socket Switch.

The accompanying illustrations show the Bergmann dust-proof plug-socket switch with locking device. This plug-socket switch is made for 6 amp and for circuits up to 250 volts. It is provided with a locking device which allows the switch to be cut in only when the plug is inserted, whereas the latter cannot be withdrawn before the switch is cut out. This property, together with the efficient manner in which the box can be sealed, does away completely with any danger of explosion. In consequence this type of switch is suitable for use in chemical works, laundries, gas works and similar places, as well as for mines. In designing these switches special attention has been given to make them safe against any danger of explosion and the construction is very strong. The switch is of the double-pole rotary type and has a quick-break action. The fuses used in connection with it are silver cartridge fuses, which can be supplied up to 6 amp. Screw fuse plugs were not adopted in



FIGS. 1 AND 2.—PLUG SOCKET SWITCH.

this case, in order to keep the dimensions of the box as small as possible. The pin plug, shown in Fig. 2, is made of hard rubber and is provided with an elastic tube attachment. A pin situated in the middle of the plug releases the locking gear of the switch when it is inserted into the socket and in this position the switch can only be cut in. With this arrangement it is said to be impossible to withdraw the plug when the switch is in the "on" position. The pin plug when inserted into the switch is shown in Fig. 1. The switch, fuses and plug socket

FIG. 3.—PLUG SOCKET SWITCH.

are embedded in a porcelain body, which is divided into single compartments. The two terminals for connecting the leads are placed at the front end of the porcelain body and are separated from each other by means of a porcelain bridge. The iron lid is lined with rubber, thus rendering the chamber dust tight and at the same time confining all sparks to the interior. This arrangement also prevents the entrance of moisture into the box. The cast-iron box in which the porcelain interior is mounted is provided with an outlet screwed for ⅜-in. steel conduit, as shown in Fig. 3. The adjusting screw fixed in the lid of the box serves the purpose of pressing the protecting cover over the switch and fuses, tight against the porcelain body. The device is made by the Bergmann Electrical Works, of Berlin, Germany. The concern's British representatives are Marples, Leach & Company, Limited, London, England.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

While there was very little actual improvement in trade during the week ended Aug. 4, there was a noticeable increase in the optimism of the commercial world and widespread evidence of activity in the preparations of jobbers and manufacturers for a rushing fall business. Preparations for the opening of the fall jobbing trade are to be observed in all principal centers. Buyers are already beginning to arrive in the market in large numbers. It is the general belief that the visitors are coming to buy and not merely to hunt for special bargains as has too frequently been the case in recent months. There is no disguising the fact that retail stocks all over the country are very low and that replenishing must be liberal for merchants who expect to keep up with the procession. In some portions of the country the July trade has not been as large as was anticipated, but forced sales have done much to dispose of old stocks which buying in 1907 permitted to accumulate. In the farming sections the consumers have taken advantage of the summer sales much more liberally than in the industrial centers, the result, of course, of the closing of many shops and the consequent curtailment of the public buying power. The crop reports from all sections indicate that the year will be prosperous for the farmers, and in the South there is evidence of a bumper yield. In the industries there is ample evidence of the revival which is coming, but which has not as yet arrived. Gradually more men are being put to work, but factories are still running "on orders." In iron and steel more orders are being received and, according to the report of the United States Steel Corporation, new business is coming in more actively than at any other time since last October. This, of course, means the employment of more labor, the consumption of more raw material and an increase in railroad traffic. Building interests are notably improved and the lumber trade is consequently in better shape. The "Build Now" campaign of the *American Lumberman*, has, it is claimed, produced a decidedly beneficial effect in the Northwest. By actively spreading abroad arguments and facts showing that building costs at the present time are from 15 to 30 per cent below what they were a year ago and less than they are likely to be in the future, it is believed that much idle capital has been interested. Many commercial bodies throughout the West have taken hold of the crusade and distinctly beneficial results have followed. There continue to be many expressions of the most encouraging nature from leaders in business and finance. Notable among these is that of Mr. Solomon R. Guggenheim, who, just returning from Europe, declared that there had never been exhibited abroad greater confidence in American securities than at present or greater willingness to invest in American enterprises; also that of Prof. Henry C. Adams, for 20 years in charge of statistics and accounts for the Interstate Commerce Commission, who expects an immediate return to normal conditions to be followed by the "most extraordinary prosperity in every department of industrial activity for both capital and labor which the country has ever known." He believes that the lessons taught by the hard times will lead to greater conservatism in business methods during the next era of prosperity. The business failures for the week ended July 30, according to *Bradstreet's*, were 275, as against 263 the week previous, 142 in like week in 1907, 170 in 1906, 178 in 1905 and 179 in 1904.

THE COPPER MARKET.

During the week ended Aug. 3, the domestic demand for copper displayed considerable more strength, while the demand from abroad was scarcely as persistent as it has been for the past few weeks. The strength in the market and the continued advance in price have made domestic consumers rather apprehensive that they had waited too long, and liberal purchases for immediate requirements were made. Prices were steadily marked up during the week, even under the conservative buying of consumers, until it became evident to every observer that any concerted attempt to stock up would result in a sharp advance. This creates the unusual situation where buyers wish to take hold but are afraid of the effect their purchases will have on prices. It is reported in the market that several million pounds of Lake has changed hands at from 13⅛ to 13¼ and that bids for large quantities at the higher figure have been refused. During the week the Calumet & Hecla Company, which had been selling at 13¼c. net f.o.b., finally announced its withdrawal from the market. Apropos of this it was claimed that the company is pretty well sold up for the next 30 to 60 days. Incidentally the United Metals Selling Corporation cabled its foreign agents to advance electrolytic to £61 12s. 6d., which is equivalent to a trifle under 13¼c. Foreign stocks continue to increase, although the European interests have generally supplied themselves at figures lower than those prevailing at present and are able to wait for the domestic buyers to satisfy their wants. Prominent copper authorities still report that the output in the United States, including the smelting and refining of the foreign material, is running at the rate of about 90,000,000 lb. per month, while domestic consumption is absorbing only about 30,000,000 a month, leaving a surplus of 60,000,000 lb. monthly to be exported and consumed abroad. At the same time exports during July were less than 40,000,000 lb., indicating an increase in domestic stocks during the past month of 20,000,000 lb. This would necessarily bring the total estimated surplus here up to between 125,000,000 and 135,000,000 lb. However, the heavy surplus is being carried in Europe, where the monthly consumption of American copper is still estimated in the neighborhood of 40,000,000 as a maximum. Exports from Atlantic ports during July were 17,715 tons, which is 12,000 less than in June, and the lightest since the foreign buying movement set in last September. Exports by months for the past four years are:

	1907-8. Tons.	1906-7. Tons.	1905-6. Tons.	1904-5. Tons.
July	17,715	14,646	18,309	18,478
June	29,749	16,193	18,634	22,096
May	22,640	9,010	19,260	23,758
April	31,753	17,263	16,330	24,121
March	21,620	13,006	16,433	21,073
February	24,650	9,174	15,807	17,508
January	32,944	17,089	15,307	21,245
December	37,034	13,992	18,158	19,847
November	33,787	18,451	13,195	22,294
October	28,786	17,528	17,784	26,585
September	17,157	14,119	19,755	20,569
August	13,208	20,682	22,692	24,906

Since Jan. 1 exports have been 181,061 tons, comparing with 87,381 tons in the first seven months of 1907. Exports on Aug. 3 were 75 tons. Closing prices on the Metal Exchange Aug. 3 were:

Lake	13¼ @ 13⅜
Electrolytic	13⅛ @ 13¼
Castings	12⅜ @ 13

The London market on July 31 was as follows, Aug. 1-3 being holidays:

	Noon. £ s d	Close. £ s d
Standard copper, spot	50 17 6	.. .. *
Standard copper, futures	60 12 6	.. .. *
Market	Firm.	*
Sales of spot	200 tons	
Sales of futures	1,200 tons	

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 5 0
London, futures	64 10 0	56 17 0
London, best selected	67 10 0	60 0 0

*Market closed at noon.

ALLIS-CHALMERS STEAM TURBINES.—One of the largest tanneries in the world—the Pfister & Vogel Leather Company—has just ordered two Allis-Chalmers steam turbine units, each of 1500-kw capacity, or a total of 4000 hp, for the new plant to be built in Milwaukee. Another unit of the same size has been purchased by the Pueblo & Suburban Traction & Lighting Company, Pueblo, Col., and the city of Holland, Mich., will install one of 750-hp capacity. These orders include exciters, condensers, pumps and auxiliary apparatus of every kind to complete the equipment of the power plants for which the steam turbines and generators are intended, thus forming altogether a very good indication of the general revival of business.

GROWING WESTINGHOUSE ORDERS.—The business of the Westinghouse Electric & Manufacturing Company for the month of July shows up considerably higher than that for the previous month, and the Westinghouse people look upon this fact as one of the most emphatic indications as to the general and permanent improvement in the electric business, because during the last few years, even when business was especially good, it always fell off somewhat during the summer months. It is explained that many of the industries which have held back their orders for electrical machinery as a matter of economy and because they were not busy themselves, have now become so busy that they are in urgent need of apparatus. This is possibly also the reason why most of the orders which the Westinghouse Company has taken recently were for hurry-up delivery. The orders themselves, while not exceptionally large individually, are of interest because the various sources from which they emanate show that most of the industries and manufacturing enterprises throughout the country are experiencing a revival of activity. For example, the East Pittsburg shops are now constructing generators for a steel plant at Minneapolis, Minn.; transformers for a power plant of an electric company at Seattle; locomotives for a phosphate mine in Georgia, and motors for a coal mine on the Pacific Coast; while a complete electrical equipment is being made for the operation of a felt mill in Michigan. It is also stated by one of the officials of the company that the outlook for business is very promising, and that it has many orders in sight from all parts of the country.

ELECTRIC DOCK CRANES IN MEXICO.—S. Pearson & Sons, in connection with the National Railway of Tehuantepec, and in order to obtain the most efficient results in connection with the unloading and loading vessels at Salina Cruz and Coatzacoalcos, have installed large electric cranes and capstans. At each of the terminals of the Tehuantepec Railway there have been in successful operation 18 three-ton cranes fitted with 20-hp Westinghouse motors and 30 electric capstans, each fitted with 15-hp Westinghouse motors. These motors were supplied by the British Westinghouse Electric & Manufacturing Company. By the use of these electric cranes and capstans it is possible to unload vessels into cars and load from cars to vessels in a remarkably short time. By this method no manual handling is necessary and has proved most excellent economy, reducing to a minimum the time necessary for vessels to lie in dock. These are the first electric cranes and capstans ever installed in Mexico. In connection with the lighting and power required at each of the different railway terminals, is installed a very large power plant, comprising some 1200 hp at each place; these consist of Westinghouse steam engines and generators with all the usual equipment of exciters, switchboards, etc.

SALES OF SMALL CURTIS TURBINES.—The increasing use of small Curtis steam turbines is strikingly shown by a partial list of turbines under 500-kw capacity which have been installed by the General Electric Company or are under construction. Of the 570-odd turbines listed, representing a total capacity of about 37,000 kw, 7 per cent are for the export trade. The remainder are intended for home service in central stations, marine work, laboratories of educational institutions, power and lighting plants for hotels and office buildings, laundries, mines, printing establishments and in every branch of manufacturing, such as wood-working plants, foundries, iron and steel mills, distilleries, chemical plants, ice plants, textile mills, breweries, tanneries, flour mills, shoe factories, paper mills, machine shops and ammunition manufacturing plants. Turbines for train lighting are finding a ready market. The latest application of moderate-size turbines is for driving fire pumps, in which capacity they have been very satisfactory. On board ship where a compact generating unit is required, small turbine lighting sets are also in favor.

PLANT FOR RECLAMATION SERVICE.—An initial shipment of water-cooled power transformers, forming part of an ultimate equipment of 36 transformers, aggregating 10,530 kw, for the United States Reclamation Service in connection with the Salt River, Ariz., irrigation project, has recently been made by the Wagner Electric Manufacturing Company, of St. Louis. The specifications for these transformers were issued last July, and the contract was awarded under severe requirements as to insulation, operating characteristics, etc., and also under rigid stipulations as to prompt delivery. The recent shipment comprises six 350-kw, 25-cycle, 2300-26,000-volt step-up transformers, and nine 235-kw, 25-cycle, 23,100-1100-volt step-down transformers. The design of the transformers required dealing with certain special conditions at the places of insulation, among which were the limited space for handling the transformers in the power house and the high temperature of the cooling water, due to the hot climate of the desert region. The water is circulated through the cooling coil of each transformer by a Wagner three-phase, motor-driven triplex pump.

WIRT INSULATOR MANUFACTURE.—President H. C. Wirt, of the Wirt Manufacturing Company, Burrage, Mass., advises us that the reorganization of the corporation has been completed. It has issued approximately $112,000 of preferred stock in settlement in full of all claims of its creditors and has also issued and sold at par $25,000 of mortgage bonds, which will be used as the working capital of the company, and which is now in bank. The company starts out with excellent prospects. It has in hand an order for one of its specialties to the amount of $100,000, and inquiries and orders are being received daily for more goods. Mr. Wirt regards the outlook as altogether bright.

NEW ELECTRIC PLANT IN VERA CRUZ, MEXICO.—William W. Canada, consul at Vera Cruz, Mexico, writes: "The new electric-car line of Vera Cruz was inaugurated on July 5, the 10 cars in use being from the United States, and the power plant equipment from Germany and Switzerland. The old plant of the company could not furnish power for operating small motors, electric fans, etc., during the day, but now these electric appliances will come into more general use."

INCANDESCENT LAMP MANUFACTURE IN THE SOUTH.—An electrical contractor writes that there is an excellent opportunity for the establishment of an incandescent-lamp factory in the South either for refilling old lamps or making new lamps. New Orleans is mentioned as a particularly favorable location, owing to its commercial position with respect to distribution of produce, cheap labor and concessions to manufacturing establishments with respect to taxes.

Financial Intelligence.

THE WEEK IN WALL STREET.

The market in Wall Street has been dull for the week ending Aug. 3. Prices have not shifted lower, although there have been a few losses from the high figures that prevailed during the recent upward spurt, but the volume of trading was very much decreased. The declaration by Mr. Taft in his letter of acceptance that he would pursue the Roosevelt policies had no effect upon the market. There was a large element in Wall Street which would have accepted the renomination of Mr. Roosevelt as a calamity, and which would have made it the peg upon which to hang pronounced and prolonged pessimism. The announcement by Mr. Taft that the same policies will be pursued does not cause a ripple. There is no explanation except that Mr. Taft, with his judicial training and equable temperament, is not Mr. Roosevelt. No one in Wall Street is afraid of Mr. Taft, and 90 per cent of the regulars are doing all they can to promote his election. So politics is not responsible for the decrease in the volume of trade. The most important financial feature of the week was the clearing up of the situation with regard to the Gould properties, through the financing of the $8,000,000 Wheeling & Lake Erie notes which were about to mature without there being sufficient funds in the treasury of the company to meet them. The Morgan-Harriman understanding not only achieved this, but put an end to any possible disruption of the trunk line agreements. Peace among the railroads is certainly to be desired, and this seems assured when the Morgan interests and the Harriman interests agree to bury their animosities. Wall Street generally accepts the crop situation to be thoroughly satisfactory. The regular reports of rust in the Northwest, and too much or too little rain in one section or another cuts absolutely no figure. The crops, especially cotton, are magnificent, and none is better acquainted with this fact than the professional Wall Street trader. The quarterly report of the United States Steel Corporation for the second quarter of the year was distinctly encouraging. While the gross earnings were less than half what they were in 1907, they were sufficient to meet the dividend on the common stock and leave a small surplus besides. The evidence of conservatism in the management of the company has helped to keep the stock at a figure which is high in comparison with other investment securities. The men of the Street were willing to pass over the figures of the report hurriedly, but to remember and re-

peat the assurance, which was given, that for the 24 days in July, before the report was published, the bookings of new business averaged 26,000 tons per day, the best record shown since before the financial crash last fall. The report shows that the gross earnings for the last four quarters have not been small enough to cause disturbance and that the surplus has steadily increased. Net changes for the week were for the most part advances, although there were few of sufficient importance to attract especial attention. Copper stocks and the smelters were strong on the better conditions that prevailed in the copper market and the general tone was firm enough to prevent declines, even where buyers were so few that trading was stagnant. The money market touched bottom figures Aug. 3, when call loans were made at ¾ per cent and the highest rate was 1¼ per cent. The rate was 2½ and 3 for 90 days, but there was only a light demand, and the call from the West for crop moving has not as yet been sufficiently in evidence to cause any drain upon the banks. On Aug. 3 the trading was small, with prices inclined to sag. As has been the case for many days, the industrials were stronger than the railroads. The prices in the table are those at the close on Aug. 3.

NEW YORK.

	July 27.	Aug. 3.	Shares Sold.		July 27.	Aug. 3.	Shares Sold.
All.-Ch.	11	11¼*	800	Int.-Met., com.	11⅛	11½	2,325
All.-Ch., pfd.	33¼	34*	450	Int.-Met., pfd.	31¼	32⅛	6,630
Amal. Cop.	73½	78¼	242,250	Mackay Cos.	59	69¾	800
Am. D. T.	39*	39*	——	Mackay Cos., pfd	68¾	69⅜	600
Am. Loc.	54	56¼	26,361	Met. St. Ry.	30	30*	200
Am. Loc., pfd.	105	107	110	N. Y. & N. J. Tel.	112	112*	150
Am. Tel. & Cbl.	64½*	64¼*	——	Steel, com.	44⅝	44⅞	359,565
Am. T. & T.	121¾	121⅝	4,739	Steel, pfd.	108¼	109½	25,985
B. R. T.	52	52¾	35,370	W. U. T.	56*	55½	810
Gen. Elec.	145¾	146¼*	2,115	West'h, com.	77	78¼	5,910
Hud. R. Tel.	—	—	——	West'h, pfd.	95½	95½*	100

PHILADELPHIA.

	July 27.	Aug. 3.	Shares Sold.		July 27.	Aug. 3.	Shares Sold.
Am. Rys.	44	44	——	Phila. Elec.	9⅝	9⅞	——
Elec. Co. of A.	10⅛	10	——	Phila. R. T.	15½	15¼	——
Elec. Stor. B'ty.	35½	39	——	Phila. Traction.	90½	90½	——
E. S. B'ty, pfd.	49*	49*	——				

CHICAGO.

	July 27.	Aug. 3.	Shares Sold.		July 27.	Aug. 3.	Shares Sold.
Chi. City Ry.	176½	176½*	——	Met. El., com.	15*	15*	——
Com. Edison.	103	102	——	Met. El., pfd.	48½	48	——
Chi. Subway.	21	21*	——	Nat'nal Carbon.	70	70*	——
Chi. Tel. Co.	140	139½	——	Nat. Carb., pfd.	111	110	——

BOSTON.

	July 27.	Aug. 3.	Shares Sold.		July 27.	Aug. 3.	Shares Sold.
Am. Tel. & Tel.	122	121½	——	Mass. E. R., pfd.	47	50	——
Comb'ind Tel.	109½*	109½*	——	Mex. Tel., pfd.	—	6*	——
Edison El. Ill.	216¾	216*	——	N. E. Tel'p.	114	114*	——
Gen. Elec.	145	146¾	——	W. Tel. & Tel.	6*	6*	——
Mass. Elec. Ry.	10	10¾*	——	W. T. & T., pfd.	68	70*	——

*Last price quoted.
Shares sold are for week July 27 to Aug. 1.

DIVIDENDS.

American Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Aug. 1.

Utah Copper Company, quarterly, 5 per cent, payable Sept. 30.

Electric Properties Company, preferred, quarterly, 1½ per cent, payable Aug. 10.

Susquehanna Railway, Light & Power Company, Williamsport, Pa., preferred, semi-annual, 2½ per cent, payable Sept. 1.

United Wire & Supply Company, Providence, R. I., preferred, quarterly, 1¾ per cent, payable Aug. 1.

Carthage (N. Y.) Electric Light & Power Company, semi-annual, 5 per cent, payable Aug. 1.

HUDSON RIVER ELECTRIC POWER COMPANY.—Holders of the $4,025,000 first mortgage 5 per cent bonds of the Hudson River Electric Power Company have been asked to surrender their coupons for the next four years at par, for 6 per cent notes secured by the coupons themselves, and payable Feb. 1, 1912, or earlier, at the option of the company. In addition the bondholders are to be given a stock bonus of 10 per cent. The Knickerbocker Trust Company, of New York, is to be made the trustee for the stock and coupons. In explaining this proposal President Ashley says: "After a careful study of the affairs of the company the directors have reluctantly come to the conclusion that it would be impossible to pay the interest on the first mortgage bonds falling due Aug. 1, 1908, and this, notwithstanding the fact that until the last quarter there has been a substantial increase in gross and net earnings of the subsidiary companies. The panic found us with a floating debt of $600,000 incurred in construction, which, because of prevailing conditions, it is impossible for us to retire by sale of bonds, and the most embarrassing part of the situation is that our principal creditor is likewise a large customer of one of our subsidiary companies, and withholds payment of power bills, thus depriving the subsidiary company of revenue which, under normal conditions, would be available for interest. A large majority of the bonds have already assented to the plan."

CALUMET & HECLA MINING COMPANY.—The annual report of the Calumet & Hecla Mining Company for the year ended April 30 shows the total profit and loss surplus of the company for the year to be $4,700,964, as compared with $7,028,942 for the previous year. The company produced mineral equal to 43,264 tons of refined copper, as against 46,279 tons in the previous year. During the year dividends aggregating $50 were paid. Regarding the future prospects of the mine, President Agassiz says in his report: "In several of the previous annual reports the attention of stockholders has been called to the unsatisfactory character of the conglomerate below the fifty-seventh level in the northern part of the mine. In 1900 the conglomerate yielded about 59.93 lb. of copper to the ton. I regret to state that since then this percentage has annually been diminished. In 1902 it had fallen to 52.44 lb. to the ton. For the past fiscal year its yield was 39.68 lb. To maintain our product we have stamped an additional amount of conglomerate rock in addition to the amygdaloid rock mined from the Osceola lode which has increased from 74,235 tons in 1905 to 603,891 tons in 1907-08. The amount of conglomerate stamped has gradually increased from 1,464,697 tons in 1900 to 1,894,176 tons in 1907-08."

ROCHESTER TRACTION BONDS AUTHORIZED.—The Public Service Commission of the Second District of New York has issued a supplemental order permitting the Rochester, Corning & Elmira Traction Company to issue capital stock to the amount of $380,000 par value and to issue $1,000,000 in bonds. The money is to be used to build the road from Rochester to Conesus Lake. The original application of the company was for the issuance of $8,000,000 in bonds and of the balance of its stock of $3,880,000. The company had previously issued $120,000 capital stock. The first order of the commission permitted an issue of $4,120,000 in bonds and the full issue of $4,000,000 in stock. The commission required that the capital stock be subscribed to by responsible parties before any bonds could be issued, which money should receive no return until after the interest of the bonds was paid. The promoters of the road reported it was impossible to dispose of the stocks and bonds under these conditions, but stated they would be able to do so if they were allowed first to construct and put in operation that part of the road from Rochester to Conesus Lake, a distance of 25 miles, at an estimated cost of $1,350,000.

EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON.—The report for the fiscal year ended June 30, 1908, of the Edison Electric Illuminating Company, of Boston, with June partially estimated, shows gross earnings of $4,242,000, as against $4,020,620 for the previous year. The capital stock of the company is now $14,128,600, and the gross revenue was, therefore, a trifle more than 30 per cent on the capital stock. This is an increase of 5.4 per cent over the previous year. The excellent condition of the company is shown from the fact that while the capital stock has been increased a little more than $4,000,000 within the past five years, there has been spent for betterments and improvements $7,262,510, not including the expenditures for the fiscal year just closed. The surplus left for the stockholders on the year's business is about $1,560,000, or more than 12 per cent. At the close of the year the total connected load on the system in 16-cp equivalents was 1,638,544, or nearly 9 per cent in excess of the previous year. This increase was accomplished, although the net connections were decreased during the last seven months some 61,000 loads.

NEW TRACTION FOR ROANOKE, VA.—The Roanoke Traction & Light Company has just been incorporated in Virginia, with James P. Woods, president; R. C. Jackson, vice-president, and James C. Martin, secretary and treasurer. These officers, all of whom live in Roanoke, are named as the incorporators. The minimum capital is to be $500,000 and the maximum $2,000,000. The charter empowers the company to own, lease and operate all sorts of heating, lighting and power plants, and says the principal terminal places shall be Roanoke, Lynchburg and Clifton Forge, Va., with the main power-producing plant in Roanoke. The estimated length of the proposed line of construction or improvement is 200 miles. The officers of the company named above, and W. W. Coxe and Joseph H. Chitwood, compose the board of directors.

CONVERTING AMERICAN LIGHT & TRACTION NOTES.—Within the past fortnight large blocks of the 6 per cent five-year notes of the American Light & Traction Company have been converted into common stock at par. The rush to sell this newly-acquired stock, which had been selling at about 115, broke the price to 108, and it is unlikely that any other conversions will be made. The notes, aggregating $1,500,000, were issued Oct. 1, 1907, to run 18 months and were convertible at option. Not many notes were converted until the recent advance in the stock took place. In spite of the adverse business conditions the earnings of the company for the year ended June 30, 1908, show some increase over those for the previous year. The net earnings are $2,499,257, as compared with $2,312,965 in 1907. The balance left for the common stock after charging off $681,000 for a reconstruction reserve, and paying the customary preferred dividends, was $964,085, or 14.20 per cent. This compares with $777,193, or 11.45 per cent in 1907. This excellent showing has not been made at the expense of the company, as is shown in the detailed report, for $521,971 was spent for maintenance alone. The reconstruction reserve of the company now amounts to $1,702,000.

REORGANIZATION OF RICHMOND, VA., TRACTIONS.—A proposition has been made looking to the reorganization and consolidation of the Virginia Passenger & Power Company and the Richmond Traction Company and its controlled lines. The plan provides for the organization of a new company under the laws of Virginia to acquire and operate the properties. It is proposed that this company shall have a capital stock of $12,500,000, of which $7,500,000 shall be common and $5,000,000 non-cumulative preferred stock, entitled to dividends not exceeding 5 per cent a year up to Jan. 1, 1914, and thereafter at a rate not exceeding 6 per cent a year. A bond issue to the amount of $15,000,000 is proposed. The bonds are to bear interest at the rate of 5 per cent, run 25 years and be secured by a first and refunding mortgage or deed of trust, which will be a first mortgage lien on a large part of the property of the new company.

TRACTION MERGER PROPOSED IN COLUMBUS, OHIO.—A plan is on foot looking to the consolidation of all the lighting and street railway interests in Columbus, Ohio, through the incorporation of the Columbus Light, Heat & Power Company, with a capital stock of $2,000,000, by Edwin R. Sharp, William K. Lanman, H. Waite, George Hardy and H. T. Stewart. The purpose of this company, it is stated, is to purchase all the properties and franchises of the Columbus Publis Service Company, with the intention of leasing them to the Columbus Railway & Light Company, which is already operating all the city railway lines and the lighting properties of the Columbus Edison Company. With the exception of the municipal plant, this merger would unite the complete control of the lighting, as well as the railway business of the city. Robert Sheldon is the president of the Columbus Railway & Light Company.

UNITED RAILWAYS COMPANY, OF ST. LOUIS.—The report for the six months ended June 30, shows that the United Railways Company, of St. Louis, did not earn enough, by $14,081, to pay the regular 2½ per cent dividend on its preferred stock. Gross earnings for the six months were $5,163,555, a decrease of $124,057 from the same six months in 1907. The net income after paying fixed charges was $410,499, an increase of $35,243 over last year. The preferred stock of the company has been increased $4,000,000 over last year on account of the absorption of the St. Louis & Suburban Railway Company. This increases the dividend account $200,000 per year.

CHICAGO CONSOLIDATED TRACTION COMPANY.—Two bondholders' protective committees are now organized in connection with the issue of $6,750,000 of 4½ per cent bonds of the Chicago Consolidated Traction Company. The first of these, headed by Mr. J. N. Wallace, of New York, represents almost entirely the $4,500,000 bonds owned by the estate of Charles T. Yerkes. The other bondholders have recently organized a separate committee, with Mr. William F. Harrity, of Philadelphia, as chairman.

WESTERN UNION BUSINESS IMPROVING.—Officials of the Western Union Telegraph Company declare that the business during July shows considerable improvement over that of June, and, in fact, over any month since the beginning of the year. The improvement is general all over the country and the increase in the number of messages is due to the more active conditions of business. The officers of the company are convinced there will be no strike of operators this fall.

NORTH AMERICAN COMPANY.—It is stated by the management of the North American Company that the company has paid off practically all of its floating indebtedness and has now outstanding only the $5,000,000 five-year notes which are due in 1912. Since Jan. 1 the company has paid $2,810,333 indebtedness out of current receipts. It is understood that in a few months the company will offer for sale $2,000,000 or $3,000,000 of new bonds of the Union Electric Light & Power Company, of St. Louis.

PHILADELPHIA COMPANY'S NOTES.—The new issue of $2,600,000 6 per cent notes of the Philadelphia Company, Pittsburg, are being offered on a basis to yield the investor from 6 to 6⅛ per cent. The notes mature semi-annually from June 1, 1909, to Dec. 1, 1913. The money raised from these notes will be used to reimburse the company for advances made to subsidiary companies. The total amount the company has invested in the securities that will be deposited with the trustee as security for these notes is $5,666,000.

BONDS FOR NEW LONG ISLAND TRACTION.—The South Shore Traction Company, which proposes to build from Rockville Center to Brook Haven, L. I., has filed a mortgage in Suffolk County, N. Y., for $3,000,000 to the Empire Trust Company of New York. The company proposes to issue 5 per cent bonds, the proceeds to be used for construction purposes.

REPORTS OF EARNINGS.

	Gross earnings.	Operating expenses	Net earnings.	Charges.	Surplus.
Northern Ohio Traction & Light. June, 1908	$174,444	$98,895	$75,549	$44,431	$31,429
June, 1907	182,241	100,807	81,434	43,549	37,185
Philadelphia Company. Six mos., Jan. 1 to June 30, 1908	8,620,949	5,062,544	3,558,405	2,233,643	1,442,037
Six mos., Jan. 1 to June 30, 1907	9,963,522	6,065,669	4,046	2,161,989	1,884,025
Birmingham Railway, Light & Power Company, June, 1908	194,293	118,646	75,645	43,846	31,800
June, 1907	161,093	111,114	49,979	39,131	10,848
Knoxville Railway & Light Company, June, 1908	48,977	24,933	24,044	11,421	12,623
June, 1907	51,852	25,401	26,451	10,619	15,832
Memphis Street Railway Company, June, 1908	140,882	87,092	53,790	34,876	18,914
June, 1907	144,709	83,709	61,642	33,606	28,036
Nashville Railway & Light Company, June, 1908	130,994	73,622	57,372	32,069	25,303
June, 1907	128,273	74,732	53,541	29,033	24,508
Little Rock Railway & Electric Company, June, 1908	54,046	30,271	23,775	10,205	13,570
June, 1907	52,742	27,262	25,480	8,398	17,082
Massachusetts Electric Companies, April 1 to June 30, 1908	1,995,842	1,214,707	781,135	466,192	314,943
April 1 to June 30, 1907	1,924,333	1,252,178	672,155	449,498	222,657
Detroit United Railway Company, Jan. 1 to June 30, 1908	3,285,428	2,110,307	1,175,121	812,973	390,757
Jan. 1 to June 30, 1907	3,286,869	2,105,239	1,181,630	769,078	440,791
Denver Gas & Electric Company, year ending June 30, 1908	2,062,326	1,210,170	825,156	378,601	473,555
year ending June 30, 1907	1,834,950	1,121,585	713,365	368,828	344,537
Twin City Rapid Transit, Jan. 1 to June 30, 1908	2,982,849	1,535,589	1,447,260	644,427	802,833
Jan. 1 to June 30, 1907	2,848,614	1,397,142	1,451,472	586,316	865,156

GENERAL NEWS

Construction News.

BERRY, ALA.—The Home Telephone Company is planning to install a telephone exchange in Berry and the erection of a long-distance line from this city to Oakman.

BIRMINGHAM, ALA.—Plans are being considered by the Board of Revenue for the installation of an electric light and steam heating plant in the courthouse and county jail, at a cost of $10,000.

CLANTON, ALA.—The Clanton Light & Power Company will install a new engine and boiler in its plant. J. P. Van Derveer is general manager.

ELBA, ALA.—Plans are being considered by the Pea River Power Company to erect a 3000-hp plant on the Pea River at Elba. H. D. Boyd, secretary and treasurer.

NORTH BIRMINGHAM, ALA.—The citizens are contemplating the construction of a 20,000-kw electric light plant in connection with the water works system. The plant will be operated by water power. W. C. Harkins is treasurer and manager.

TALLADEGA, ALA.—The Alabama Development Company is planning to extend its transmission lines to take in the residence districts and to furnish electricity for small motors. J. M. Wolfe is manager.

WILLIAMS, ARIZ.—The Grand Canyon Electric Light Company will expend from $6,000 to $10,000 in establishing a water works system in connection with its electric light plant. No bids will be called for in connection with the work. J. H. Hendson, of Williams, is engineer.

ALAMEDA, CAL.—The City Council has granted the Southern Pacific Railroad Company permission to change its motive power from steam to electricity on two of the lines now in operation in Alameda, and has also advertised for sale the franchise covering the three proposed extensions which will unite all the Alameda local lines with a line on Eighth Street, leading into Oakland.

ESCONDIDO, CAL.—The stockholders of the Escondido Mutual Water Company have voted in favor of the municipal electric lighting and power plant being installed and operated in connection with the water plant at a cost of about $30,000. The directors of the water company are authorized to contract for all material and machinery required for the generating plant. It is proposed to erect the power plant about one-half mile west of the reservoir where a fall of 400 ft. can be secured.

MODESTO, CAL.—The Board of County Supervisors have accepted the bid of the La Grange Mining & Power Company for a franchise for the construction and maintenance of transmission lines for the distribution of electricity for lamps and motors in Stanislaus County, in the district between the Toulumne, Stanislaus and Merced Rivers.

RED BLUFF, CAL.—H. P. Stice has filed an amended notice of an appropriation of 12,000 cu. in. of water on Mill Creek, to be used to generate electricity. The water will be diverted by means of a dam across the creek, thence by ditch and flume.

SACRAMENTO, CAL.—The City Council is considering the question of compelling the telephone companies to place their wires underground in the business section of the city.

SAN FRANCISCO, CAL.—Contracts have been placed for the construction of the Ocean Shore Railway between San Francisco and Santa Cruz. Contracts will soon be awarded for the construction of the railway between Granada on the north and Scotts Creek on the south, a distance of 37 miles.

SANTA CRUZ, CAL.—The Big Creek Power Company is installing a 500-kw Curtis steam turbine. S. W. Coleman is manager.

LAKE CITY, COL.—The Hinsdale Mining & Development Company contemplates the construction of a 500-hp power station and transmission line. John H. Hammond is manager.

STERLING, COL.—The Colorado Telephone Company is making arrangements to construct a telephone line from Sterling to Julesburg, which will connect Denver with all the towns in northeastern Colorado.

HARTFORD, CONN.—The New York, New Haven & Hartford Railroad Company has awarded the contract for the construction of an electric railway from the present terminus in Weathersfield to Middletown, Conn., to C. W. Blakeslee & Son, of New Haven, Conn., for $400,000.

TORRINGTON, CONN.—The Torrington Electric Light Company is planning to extend its system to Litchfield and will change the voltage from 1100 to 2300 volts. Arrangements have been made with the Southern New England Telephone Company to use its poles from Torrington to Litchfield. F. M. Travis is vice-president.

WASHINGTON, D. C.—Arrangements are being made to light the Conduit Road from the Aqueduct Bridge to the District line. It is proposed to erect 110 incandescent electric lamps of 40 cp.

WASHINGTON, D. C.—Bids will be received at the office of the constructing quartermaster of the Walter Reed Army General Hospital, Takoma Sub-station, Washington, D. C., until Aug. 15 for installing approximately 1100 ft. four-way electric conduit, with necessary manholes, etc. Plans, specifications and further information furnished on application. Captain H. L. Pettus is quartermaster.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 11, for furnishing at the navy yards and naval stations the following supplies: Washington, D. C., Schedule 147—electric fans; also until Aug. 18, as follows: Norfolk, Va., Schedule 174—35,000 arc lamps carbons; fuses; electrical supplies, switches, weatherproof wire, rubber-covered wire; Boston, Mass., Schedule 165—Feeder panels; Washington, D. C., Schedule 165—2500 ft. circular loom; Schedule 174—electrical supplies; switches and rubber-covered wire. Applications for proposals should designate the schedules desired by number. E. B. Rogers is paymaster general, U. S. N.

WASHINGTON, D. C.—Bids will be received until Aug. 11 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards and naval stations the following supplies: Portsmouth, N. H.: Schedule 112—Motor-driven splitting shears; motor-driven counter-sinking machine. Schedule 147—3000 ft. interior communication cable. Norfolk, Va.: Schedule 113—Electric traveling hoist; motor-driven key seater; two motor-driven pipe machines; electric water tool grinder; double duty shaper; three screw-cutting engine lathes; constant speed electric motor. Also until Aug. 18 as follows: Puget Sound, Wash.: Schedule 116—Magnet wire. Annapolis, Md.: Schedule 156—Two motor-driven pumps, a direct-current motor and a switchboard. Applications for proposals should designate the schedules desired by number. E. B. Rogers is paymaster general, U. S. N.

PENSACOLA, FLA.—Louis Boley, of Pensacola, has applied to the City Council for a franchise for an electric railway from Wayne through this city and to Olive, about 10 miles distant.

EAST POINT, GA.—The East Point Light & Power Company is planning to erect an electric light plant and water works system to supply the city with electricity and water. The cost of the building is estimated at $2,500, and the electrical machinery about $9,000. E. H. Davis, of Griffin, Ga., will have charge of the construction of the plant.

FORT SCREVEN, GA.—The contract for installing the electric lighting and power system in batteries, torpedo structures and range stations at Fort Screven has been awarded to the Electric Supply Company, Savannah, Ga. Col. Daniel C. Kingman is in charge of the Savannah District.

VIDALIA, GA.—The managers of the municipal electric light plant are planning to erect about one mile of additional transmission lines. J. W. Jordan is superintendent.

LEWISTON, IDAHO.—Preliminary plans are being prepared by the Umatilla Mining Company for the construction of a power plant at the confluence of the Clearwater River and Ten Mile Creek. The property of the company is located near Orogande. Jacob Schlooser, of Chicago, Ill., is president of the company.

BELLEVILLE, ILL.—The Retail Merchants' Association is considering plans for the construction of an electric light plant to supply electricity to the merchants on Main Street, North and South Illinois Streets. The cost of the plant is estimated at about $20,000, and a committee has been appointed to investigate the matter.

CHICAGO, ILL.—Plans are being made by the Chicago Telephone Company to take over the Zion City telephone plant, which has been operated as a private system, the franchise having been granted to Alexander Dowie. A franchise has been granted to the Chicago Telephone Company.

CHICAGO, ILL.—Bids will be received by the Board of Trustees of the Sanitary District of Chicago until Sept. 2 for removal of the existing channel spans of the Campbell Avenue Bridge, and the construction of new single leaf channel spans and supplying the necessary machinery and electrical equipment therefor, said spans to consist of four parallel double-track, through, single-leaf Scherzer rolling-lift bridge. I. J. Bryan is clerk.

COLUMBIA, ILL.—The citizens are considering the question of installing a new generator in the municipal electric light plant. E. L. Rauch is manager.

GILLESPIE, ILL.—The United Electric Light & Power Company contemplates extending its lines and using meters. C. W. Smith is secretary and manager.

MARSEILLES, ILL.—The Marseilles Land & Water Power Company contemplates the construction of a new power house and installing two 600-kw, 2300-volt, 60-cycle, three-phase generators; also the extension of its transmission lines to Ottawa. D. J. McLeod is superintendent.

PAXTON, ILL.—The installation of an ice plant is under consideration by the Paxton Electric Company. J. W. M. Burton is manager.

VERMONT, ILL.—A new street lighting system is to be installed in connection with the municipal electric light plant. Edward Feaster is manager.

WINCHESTER, ILL.—The Winchester Electric Company now purchases electrical energy for operating its system from a plant about 15 miles distant, and will dismantle the local power station and is offering the generators and engines for sale. W. Milhous is president and manager.

ALEXANDRIA, IND.—The Penn American Plate Glass Company is installing in its factory a number of electric cranes, two new 200-hp engines, a 400-hp electric generator and making other improvements, including the complete electric power equipment of the plant.

ANDERSON, IND.—The merchants and business men are interested in a project to have the business streets of the city illuminated by arches instead of by single arc lamps. The merchants propose to erect steel arches at the intersection of the streets if the city will furnish electricity for the lamps. There will be about 200 incandescent lamps to each arch.

FORT WAYNE, IND.—The Fort Wayne Power Company contemplates rebuilding its dam and the reconstruction of its water turbines. F. H. Schmidt is secretary and treasurer.

THORNTON, IND.—Arrangements are being made to install a 50-kw dynamo and gas or gas producer engine in the municipal electric light plant this fall. W. E. Young is manager.

WARSAW, IND.—The independent telephone companies of Warsaw, Nappanee and South Bend are making arrangements to erect an all-copper circuit between the three places.

BURLINGTON, IA.—Extensive improvements are contemplated to the plant of the People's Gas & Electric Company, including the installation of new boilers, stokers and coal handling machinery. C. H. Walsh is secretary and manager.

EAGLE GROVE, IA.—Plans are being considered for increasing the output of the Citizens' Light, Heat & Power Company's plant. The plans include the installation of an additional boiler, the replacing of the present direct-current dynamo with a larger machine, or the addition of an additional generator. J. A. Innes is secretary and manager.

NEVADA, IA.—The Nevada Electric Company contemplates increasing the output of its plant by the installation of an additional engine and generator. M. A. Harrison is secretary and manager.

PELLA, IA.—Extensive improvements and additions are contemplated for the plant of the Pella Electric Company, including the installation of new boilers, engines and generators, and the establishment of a day power service. W. H. Fowler and H. J. Rhynsburger are owners of the plant.

PERRY, IA.—The Hawkeye Telephone Company is planning to erect a new exchange building in Perry and to rebuild the entire system, which will involve an expenditure of about $20,000.

STORM LAKE, IA.—The Storm Lake Electric Light & Power Company will install a new 100-hp boiler in its plant. Frank W. Mack is president and manager.

HOISINGTON, KAN.—We are informed that it is proposed to change the system of the Hoisington light and ice plant to 2200 volts and install a 75-kw and a 30-kw generator, also a 120-hp Corliss and a 40-hp high-speed engine in the plant. A. W. Lewis is manager.

LARNED, KAN.—Improvements to the local telephone system are contemplated, at an expenditure of about $10,000. H. T. Taylor and Dr. Sharp are owners of the system.

LAWRENCE, KAN.—Plans are being made to construct an electric railway from Lawrence to Ottawa, and a company composed of local and Ottawa capitalists will probably be organized soon for the purpose. W. R. Stubbs, of Lawrence, is interested in the project.

MOUNDRIDGE, KAN.—Plans have been prepared by Burns & McDonnell, of Kansas City, Mo., for a combined light and water plant for this city.

NEWTON, KAN.—The Atchison, Topeka & Santa Fé Railway Company contemplates installing a 100-kw dynamo and engine, direct connected, in its electric plant. The plant furnishes electricity for lamps and motors for its railway shops, offices and depot in Newton. W. E. Hodges, of Chicago, Ill., is purchasing agent.

TOPEKA, KAN.—Plans are being considered for increasing the output of the municipal electric light plant to supply electricity for 500 arc lamps. H. K. Goodrich is superintendent.

BURNSIDE, KY.—The electric plant of the Burnside Electric Light & Power Company has been purchased by A. S. Hatch, who proposes to organize a public service company and make extensive improvements to the plant, changing the system to hydro-electric and developing other industries.

COLSON, KY.—The Upper Rockhouse & Beaver Creek Telephone Company will erect a telephone line from Colson to Tocsin.

OWENSBORO, KY.—Plans are being considered to build an addition to the power station of the municipal electric light plant and install a 500-hp boiler. E. H. Breidenbach is manager.

PIKEVILLE, KY.—The Pike Light & Power Company is planning to install a 150-hp boiler, one 75-kw, 220-volt, direct-current generator and an engine of 100 hp. The company also proposes to establish a day circuit with about 70 fans connected. L. L. Stone is owner and manager.

RUSTON, LA.—The citizens have voted to issue $50,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant and water works system. E. S. Gray is superintendent.

FARMINGTON, MAINE.—Work will soon commence on the construction of the dam at Cleveland Rips in North Anson on the Carrabasset River by the Franklin Power Company, which was chartered in 1903 under the name of the Carratunk Power Company, with a capital stock of $100,000, to furnish Farmington, New Vineyard and ultimately the town of Wilton with electricity for lamps and motors. The company expects to have its plant in operation in Farmington by October.

RANGELEY, MAINE.—The Rangeley Light & Power Company is considering the question of doubling the output of its plant during 1909, which will require an expenditure of about $50,000. D. D. Elliott is president and manager.

CONCORD, MASS.—Plans are being considered for the installation of a 300-kw unit in the municipal electric light plant in the near future. Albert W. Lee is manager.

EASTHAMPTON, MASS.—The Easthampton Gas Company is contemplating the installation of a 100-kw alternating-current, three-phase generator and switchboard panel in its electric plant. George L. Manchester is treasurer and manager.

MANCHESTER, MASS.—At a special town meeting held July 22 the citizens voted not to acquire the plant of the Manchester Electric Company.

OAK BLUFFS, MASS.—The Vineyard Lighting Company, of Oak Bluff, has been granted a franchise by the Board of Selectmen of Vineyard Haven, Mass., to supply electricity for lamps and motors in Vineyard Haven. Work has commenced on construction of the transmission line, which will be about two miles in length. Eugene Carpenter is treasurer.

WILLIAMSBURG, MASS.—The plant and holdings of the Mill River Electric Light Company has been purchased by the Massachusetts Lighting Companies, and electricity for lamps and motors for Haydenville and Williamsburg will be furnished from the Northampton plant as soon as the necessary connections can be made. A 24-hour service will be established and the service greatly improved. C. B. Day, of Northampton, will have charge of the system. C. F. Doe will be in active control.

CLIO, MICH.—J. H. O'Rourke, owner of the local electric light plant, is erecting new poles and extending the transmission lines in the town, and also contemplates installing a new boiler and feed pumps in the plant.

COLDWATER, MICH.—The city will erect a new boiler house and install new boilers in the municipal water and light plant. William H. Friedrich is superintendent.

GREENVILLE, MICH.—The Citizens' Telephone Company is planning to place its wires in underground conduits in this city.

GRAND RAPIDS, MICH.—The municipal street lighting system will be extended by the installation of 25 additional arc lamps. Samuel A. Freshney is secretary and manager.

HARBOR SPRINGS, MICH.—Plans are being considered to increase the equipment of the municipal electric light plant to include the installation of an additional generator and engine with a rating of from 350 to 450 kw. H. C. Metz is manager.

LUDINGTON, MICH.—The Stearns Lighting & Power Company is making extensive improvements to its power station in the Fourth Ward, which will double the output of the plant. The improvements include enlarging the power house, installing a 1000-hp unit, consisting of a generator and engine.

NORTHVILLE, MICH.—Plans are being considered to install a 150-kw, two-phase generator and engine direct connected in the municipal electric light plant. Samuel Wilkinson is manager.

WAYLAND, MICH.—The plant of the Wayland Light & Power Company will soon be sold on foreclosure. The plant has been operated by the Hanlon & Pickett Light & Power Company under a five-year lease.

ALEXANDRIA, MINN.—The contract for reconstructing the electric light and water plant and system was awarded to J. G. Robertson, of St. Paul, for $22,591, not including stokers and pole line. Edwin P. Burch, Guaranty Building, Minneapolis, is engineer.

BRAINERD, MINN.—The citizens voted on July 14 to issue $12,000 in bonds, the proceeds to be used to improve the municipal electric light plant and to purchase the water works system. R. Baker is superintendent.

BUHL, MINN.—The contract for improvements to the municipal electric light plant and water works system was awarded to R. B. Whitacre & Company, St. Paul, Minn., for $22,013.

CLARKFIELD, MINN.—Plans are being considered to change the system of the electric plant of the Clarkfield Roller Mill & Electric Light Company to the three-wire system. George H. Ledbetter is secretary and manager.

GLENCOE, MINN.—The Glencoe Electric Light Company contemplates installing steam turbines with a rating of 150 kw. A. H. Lane is manager.

GRACEVILLE, MINN.—The output of the municipal electric light plant is to be increased by the installation of a larger boiler, engine and generator. H. A. Raitz is superintendent.

PIPESTONE, MINN.—The Pipestone Electric Light, Heat & Power Company, contemplates installing a direct-connected, 100-kw, 250-volt, direct-current generator in its plant. Carl Oppen is superintendent.

VERNDALE, MINN.—It is proposed to substitute a gas producer plant for the steam plant in the municipal electric light plant in the near future. N. A. Lee is superintendent.

LEXINGTON, MISS.—The Lexington Company & Oil Mill Company is planning to establish a day circuit. G. A. Wilson is president and manager.

OKOLONA, MISS.—The question of installing new boilers in the municipal electric light plant is under consideration. A. W. Johnson is superintendent.

RICHTON, MISS.—The Richton Light & Power Company will install a 100-hp boiler in the near future. S. E. Shannon is manager.

BRAYMER, MO.—The Braymer Light & Power Company is making extensive additions to its plant, including the installation of a 100-hp engine and two 25-kw, 125-volt dynamos. C. P. Dorsey is manager.

CARTHAGE, MO.—The Empire Electric Power & Supply Company has acquired a water power about six miles from Carthage and will install water wheels and alternators and erect a three-phase transmission line to supply electricity to the local system. R. J. Claflin is secretary and manager.

INDEPENDENCE, MO.—The city light department is planning to extend the transmission lines of the municipal electric light plant about two miles. B. F. Wallace is superintendent.

JOPLIN, MO.—The Missouri & Kansas Telephone Company contemplates placing its telephone wires underground in Joplin at an estimated cost of $200,000.

KANSAS CITY, MO.—W. F. Lyons has applied to the City Council for a light and power franchise, and proposes to erect an electric power and ice plant. The cost of the buildings is estimated at $40,000.

LIBERTY, MO.—The Clay County Telephone Company is making arrangements to install a telephone system in this place, for which the company was recently granted a franchise.

MONTGOMERY CITY, MO.—The Montgomery Ice & Electric Company is planning to rebuild its plant during the next year. Luther Stover and David Stover are owners of the plant.

NEOSHO, MO.—The Neosho Electric Light Company contemplates installing a 150-hp high-pressure boiler. S. W. Carver is manager.

CULBERTSON, MONT.—The Montana Star Telephone Company is planning to erect a telephone line between Culbertson and Redstone.

BEAVER CROSSING, NEB.—The Beaver Crossing Electric Light & Power Company is considering the question of installing a storage battery in its plant. Charles C. Diers is manager.

NORTH PLATTE, NEB.—Plans are being made by the North Platte Electric Light & Power Company for extensive improvements to its plant, including the purchase of a 250-hp boiler, a 225-kw generator and an engine of 125 hp; also changing the system to three phase, 60 cycles. The company also contemplates establishing a day service. Lester W. Walker is treasurer and manager.

PENDER, NEB.—An election will be held Aug. 18 to vote on the proposition of issuing bonds for establishing a municipal electric light plant.

RED CLOUD, NEB.—The managers of the municipal electric light plant will install 10 new arc lamps and a small unit for day service. Some new circuits will also be built. Oscar Burroughs is superintendent.

KEENE, N. H.—John P. Rust has installed an electric plant to operate his pail shop. The equipment includes a 250-hp engine direct connected to a two-phase, alternating-current generator and a 150-hp tubular boiler. Two-phase motors have been installed to operate the machinery.

PORTSMOUTH, N. H.—The Rockingham Light & Power Company is extending its transmission lines from Little Boar's Head out toward North Hampton to furnish electricity for lamps to residences in that vicinity.

HAMMONTON, N. J.—The Hammonton Electric Light Company will install a new alternating-current generator and boiler. R. H. Garrison is superintendent.

LAS CRUCES, N. M.—Plans are being considered to utilize the water power of the Falls of Rio Grande, located about four and one-half miles above the Selden diversion dam, to generate electricity for lamps and motors for the valley, Las Cruces and El Paso. It is proposed to organize a company to build the plant.

ALBANY, N. Y.—The Albany Electric Illuminating Company has placed a contract for the installation of a new street lighting system, at a cost of about $59,000.

BROOKLYN, N. Y.—Bids will be received by the Commissioner of Water Supply, Gas & Electricity, 21 Park Row, Borough of Manhattan, until Aug. 12 for furnishing, installing, maintaining and reserving for the use of the high-pressure fire service all apparatus and equipment necessary for generating and transmitting 1830 kw of three-phase 6600-volt 25-cycle electrical power, and furnishing and delivering this power under the terms of this contract, from August 15, 1908, to Dec. 31, 1908, at each of the high-pressure fire service pumping stations located in the Borough of Brooklyn at Furman and Joralemon Streets and at Willoughby and St. Edwards Streets, respectively. Blank forms may be obtained at the office of the Department of Water Supply, Gas and Electricity. John H. O'Brien is commissioner.

CORNING, N. Y.—Plans are being prepared by the Corning, Keuka Lake & Ontario Railway Company for its proposed railway between Savonia and Wayne, a distance of 18 miles, for which bids for cars and electric equipment will be asked in the near future. The railway will be operated by steam until the electric installation can be made. The company expects eventually to construct a hydro-electric plant at Little Lake, where it is estimated that 7000 hp can be developed. C. A. Baldwin is president of the company with offices at 30 Church Street, New York, N. Y.

FALCONER, N. Y.—W. E. Conden, owner of the Falconer electric light plant, will install producer gas engines in his plant and establish a day service.

FRANKLIN, N. Y.—The Delaware & Otsego Light & Power Company contemplates extending its transmission line to Sidney Center and neighboring towns. E. E. Mackey is president and manager.

GREENPORT, N. Y.—Plans are being considered to increase the output of the municipal electric light plant by 75 kw. H. H. Wilson is superintendent.

HORNELL, N. Y.—The Hornell Electric Company contemplates installing direct-current dynamos and additional feeders. L. T. Mason is secretary and manager.

ITHACA, N. Y.—The Public Service Commission has granted the application of the Ithaca Street Railway Company for permission to exercise the franchises granted by the City Council in May, which will allow the company to double-track its railway and to make other needed improvements to the street railway system in the city.

NEW YORK, N. Y.—Bids will be received by the Commissioner of Water Supply, Gas and Electricity, 21 Park Row, New York, N. Y., until Aug. 12, for furnishing, installing, maintaining and reserving for use all apparatus and equipment necessary for generating and transmitting 3250-kw, three-phase, 6600-volt, 25-cycle electrical power and furnishing and delivering this power under the terms of this contract from Aug. 15, 1908, to Dec. 31, 1908, at each of the high-pressure fire service pumping stations, located in the Borough of Manhattan, at Oliver and South Streets and at Gansevoort and West Streets, respectively. Blank forms may be obtained at the office of the Department of Water Supply and Electricity, New York. John O'Brien is commissioner.

PORT DEPOSIT, N. Y.—The Port Deposit Electric Company will substitute 40-cp tungsten lamps for those now in use. Walter Flint is manager.

RIVERHEAD, N. Y.—The South Shore Traction Company has filed a mortgage for $3,000,000 to the Empire Trust Company, of New York, N. Y. The company is planning to construct and operate an electric railway from Rockville Center to Brookhaven, N. Y.

ROCHESTER, N. Y.—The Public Service Commission, Second District, has issued a supplemental order granting the Rochester, Corning, Elmira Traction Company permission to issue capital stock to the amount of $380,000 par value and $1,000,000 in bonds. It is provided that the proceeds of the stock and bonds is to be used exclusively for the construction and equipment of the proposed road from Rochester to Conesus Lake, and that any excess shall be held for further orders of the commission. The original application of the company was for the issuance of $8,000,000 in bonds and the balance of its stock of $3,880,000.

CHARLOTTE, N. C.—The Chadwick-Hoskins Company, will equip its cotton mills in Charlotte to be operated by electricity in the near future. The Louise mill, of the company, has already been equipped with 750-hp motors by the Westinghouse Company, and the Chadwick and the Hoskins mills will be similarly equipped as soon as possible.

MARION, N. C.—It is reported that a $100,000 electric company has been organized here to develop a 1000-hp hydro-electric plant on the Catawba River near this town.

THOMASVILLE, N. C.—The Thomasville Light & Power Company is planning to extend its transmission line to the State Baptist Orphanage to furnish electricity for lamps and motors for the same. B. F. W. Bryant is secretary and manager.

PARK RIVER, N. D.—Plans are being considered for improvements to the municipal electric light plant, including the installation of a 125-hp boiler, heater, condenser and water purifier. G. Anderson is superintendent.

LARIMORE, N. D.—New boilers are to be installed in the municipal electric light plant. H. J. Wylie is superintendent.

CLEVELAND, OHIO.—Bids will be received by A. R. Callow, secretary Board of Public Works until Aug. 11, for furnishing and delivering on foundations at the Cleveland municipal electric light plant one compound engine direct connected to a 35-kw generator to furnish excitation for the 500-kw generator already installed and for the 1333-kw dynamo now being installed. Specifications can be obtained at the office of the Board of Public Works. W. J. Springborn is president of Board of Public Works.

COLUMBIANA, OHIO.—The Columbiana Water & Electric Light Company will install a direct-connected unit, consisting of a 100-kw alternator and engine. F. H. Grove is secretary and manager.

HAMILTON, OHIO.—Plans are being prepared for the construction of a new electric power plant to be operated by the Hamilton

Hydraulic Company. It is said that the power plant will be owned by the Harding estate and will be located in this city at the corner of Front and Buckeye Streets. Work will commence on the construction of the plant as soon as plans are prepared. The plant will be under the management of T. A. Jones, superintendent of the Harding Paper Mill, of Excello, Ohio.

LEMOYNE, OHIO.—The LeMoyne Telephone Company is planning to install a telephone exchange at Bowling Green and to erect a number of new lines during the early fall.

McCONNELLSVILLE, OHIO.—The McConnellsville-Malta Electric Company contemplates changing the voltage on the lines to 2200 and may possibly install gas engines for use in emergency. A. Durbin is secretary and superintendent.

MARTINS FERRY, OHIO.—Plans are being considered to install a 350-kw, alternating-current, direct-connected unit in the municipal electric light plant. J. C. Dunaway is superintendent.

MILFORD CENTER, OHIO.—The Union Light & Water Company will install a new boiler in its plant. L. H. Osborne is secretary and manager.

NEWARK, OHIO.—The Licking Light & Power Company is planning to make extensions to its transmission lines at a cost of about $2,000. J. Ingles Matthais is general manager.

NEW BREMEN, OHIO.—Bids will be received by the Village Council until Aug. 24 for furnishing the necessary labor and material for erecting and installing complete, or any part of the machinery and equipment for a complete alternating-current, two-phase, 60-cycle, 2300-volt system, for the municipal electric light plant, in accordance with specifications, copies of which may be obtained at the office of F. W. Schroeder, village clerk, or at the office of the Franklin Engineering Company, Douglas Building, Columbus, Ohio.

PLAIN CITY, OHIO.—The city is considering the question of purchasing new arc lamps for the municipal street lighting system. M. Macken is manager.

ST. CLAIRSVILLE, OHIO.—The question of installing new boilers in the municipal electric light plant is under consideration. John C. Nichols is purchasing agent.

TOLEDO, OHIO.—The County Commissioners have awarded the contract for lighting the court house park to the Toledo Railway & Light Company. The company is to furnish 49 ornamental poles, each bearing two arc lamps, and supply the energy for $4,410 per year.

WARREN, OHIO.—Mayor W. B. Kilpatrick has vetoed the franchise grant made by the City Council recently to the Hydro-Electric Company. He states as some of the Councilmen are interested in another corporation that is related to this company and that morally it would be wrong to make the grant. This is the new company which was organized to install an electric plant to be operated by water power. At the same time the mayor vetoed the water grant made to the Warren Water & Light Company, which furnishes the city with water for all purposes.

WEST MILTON, OHIO.—The Town Council has granted a franchise to L. A. Pearson to furnish heat, light and power in the town, also for street lighting.

YOUNGSTOWN, OHIO.—Plans are being made for the construction of an electric railway between Youngstown and Salem.

DUNCAN, OKLA.—Plans are being considered by the Duncan Light & Ice Company to increase the equipment of its plant, including the installation of a 100-kw, direct-current, three-wire, 250-volt generator direct connected. W. L. Bumpass is secretary and manager.

MUSKOGEE, OKLA.—The Muskogee Gas & Electric Company contemplates extending its transmission lines in the suburban districts. H. H. White is manager.

SALLISAW, OKLA.—The town has purchased the plant of the Southwestern Light & Power Company and is planning to install a water works system to be operated in connection with the electric light plant. W. A. London is manager.

ASHLAND, ORE.—Plans are being considered by the City Council for the construction of a municipal electric light plant. It is proposed to locate the plant on Ashland Creek Canyon, where it is believed sufficient power can be developed to supply the city with electricity for lamps and motors, and also to operate an electric railway for the city and its several springs and resorts. Frank C. Kelsey has been engaged to make a preliminary survey for the plant.

ASTORIA, ORE.—The citizens are considering a project to establish a municipal telephone system, the cost of which is estimated at about $30,000.

BEAVER, PA.—The New Castle & Beaver Falls Electric Street Railway Company is planning the construction of a new suburban electric railway from Beaver to New Castle. Charles Strohecker, of Zelienople, is president.

BLOSSBURG, PA.—The Blossburg Electric Light & Power Company contemplates installing a direct-connected dynamo and engine in its plant to supply electricity for 2500 lamps.

CHRISTIANA, PA.—A. J. Melcher, owner of the Christiana electric plant, contemplates installing a 150-hp boiler.

ENTERLINE, PA.—The capital stock of the Enterline & Halifax Telephone Company has been increased from $5,000 to $50,000, the proceeds to be used for extensions and improvements to its system.

HANOVER, PA.—The Hanover Light, Heat & Power Company has recently installed two 250-hp Keeler water-tube boilers, one 300-kw 550-volt direct-current railway machine and a 400-hp Lane & Bodley Corliss engine. Robert E. Manley is manager.

LANCASTER, PA.—The Lancaster Light, Heat & Power Company is rebuilding its Slackwater plant. The company sells its entire output to the Lancaster County Railway & Light Company. Edward D. Ruth is manager and chief engineer.

MAUCH CHUNK, PA.—The Carbon Street Railway Company has been reorganized under the name of the Carbon Transit Company and the following officers elected: Horace Lentz, president; J. C. Dolan, vice-president; Charles Neast, secretary and treasurer.

MT. CARMEL, PA.—The Edison Electric Illuminating Company has placed contracts for a 500-kw Westinghouse generator, a 750-hp Hamilton Corliss engine and two 300-hp, Keeler water-tube boilers. M. K. Watkins is president.

PECKVILLE, PA.—Arrangements are being made to erect 19 miles of transmission lines in connection with the Blakeley Borough municipal electric light plant. Thomas F. Crogan is superintendent.

ST. MARY, PA.—The St. Mary Electric Company will establish a day circuit. William Kaul is president.

TITUSVILLE, PA.—The Titusville Electric Light & Power Company is building a new plant and will install three gas engines and three 100-kw, 60-cycle, 2700-volt generators. Fred. K. Woodring is manager.

WAYNESBURG, PA.—The Waynesburg Electric Light & Power Company contemplates building a larger plant. A. B. Hoge is manager.

AIKEN, S. C.—The Carolina Light & Power Company has nearly completed the construction of a new water-power plant on Little Home Creek, which will develop 600 hp and will be used in connection with the old power house on the same stream. H. M. Dibble is president and treasurer.

CHARLESTON, S. C.—The Charleston Paper Box Company is planning to establish a plant to manufacture boxes, which will be operated by electricity. W. S. Lameau and E. H. Schirmer, Jr., are interested in the enterprise.

ONIDA, S. D.—The Great Western Telephone Company is planning to make extensions to its system, including the construction of a copper telephone line from Onida to Pierre. The company expects to erect about 500 miles of new lines before the close of the season. F. B. Rowe is manager.

SPEARFISH, S. D.—Plans are being considered for the construction of a large hydro-electric plant on the Spearfish River, the cost of which is estimated at $2,000,000.

HUMBOLDT, TENN.—The Board of Aldermen has authorized the Board of Public Works to purchase a 210-hp engine and 150-kw generator for the municipal electric light plant.

PARIS, TENN.—Plans are being made for extensions to the transmission lines of the municipal electric light plant. M. W. Younkin is manager.

RIPLEY, TENN.—The Ripley Light, Water & Ice Company is planning to move its plant and change its system to 60 cycles and to discard its direct-current service. W. A. McCallum is superintendent.

CLEBURNE, TEX.—The City Council has granted a franchise to J. H. Ransom to construct a street railway in the city.

HICO, TEX.—The Hico Electric Light Company is planning to change its system from 133 cycles to 60-cycle, three-phase, and install a 75-kw, alternating-current generator. H. G. Gleason is manager.

HOUSTON, TEX.—The County Commissioners have granted the Brunner Water & Light Company a franchise to construct an electric light plant and water works system.

STRAWN, TEX.—The Strawn Coal Mining Company will install an electric plant to supply electricity for operating the hoisting coal and shifting cars.

OGDEN, UTAH.—Arrangements are being made to construct a power plant in South Fork Canyon, 18 miles from Ogden, with an output of about 1000 hp. L. B. Spencer, of Ogden, is interested in the enterprise.

SALT LAKE CITY, UTAH.—George B. Hancock and associates have filed a notice of appropriation upon water rights in Mill Creek to be used for operating mining machinery and generating electricity.

BIG STONE GAP, VA.—The Powell Valley Light & Power Company is contemplating the erection of three miles of transmission lines. R. A. Morrison is president and manager.

FREDERICKSBURG, VA.—Charles E. Manor, of Stanleyton, Va., has been awarded the contract for the construction of a 350-hp hydro-electric plant for the City Electric Light Company.

RICHLANDS, VA.—Plans are being considered by the Town Council for the construction of an electric light plant, water works and sewer systems. C. B. Neel is chairman of committee.

ROANOKE, VA.—The Roanoke Railway & Electric Company has engaged J. J. Kennedy as engineer to prepare plans for the development of a water power at Little Tunnel, on the James River.

STRASBURG, VA.—The Rock Spring Electric Company, recently incorporated, is making arrangements to erect an electric plant, for which orders for machinery have been placed. John L. Livers, of Lancaster, Pa., is engineer in charge of the work.

BLAINE, WASH.—The City Council has purchased the plant of the Blaine General Electric Company, owned by H. L. Jenkins, the consideration being $15,000. The city will remodel the plant and expects to have it in operation in about 60 days.

COLBY, WASH.—W. E. Parker has purchased a 500-acre tract of land situated near Colby and will develop the water-power of the creek which runs through the property. A power plant will be built and electricity will be furnished for lamps and motors to the residents in that vicinity.

SEATTLE, WASH.—An ordinance has been introduced in the City Council to appropriate $12,000 for the erection of a substation at West Seattle to provide the residents on the west side of the bay with electricity for lamps. A site for the substation has been purchased. The city is also extending its transmission line to West Seattle to furnish electrical energy to operate the new pump recently purchased by the West Seattle Land & Improvement Company.

SPOKANE, WASH.—The Yakima Valley Transportation Company has decided to construct 70 miles of electric railway, the cost of which is estimated at $2,000,000. The officers of the company are: J. Splawn, of North Yakima, president; G. S. Rankin, vice-president; Murray B. Miles, secretary, and E. M. Kenley, chief engineer and superintendent.

TOPPENISH, WASH.—The City Council has awarded a franchise to Campbell & Crane, of Seattle, for the installation of an electric light plant.

WATERVILLE, WASH.—Application has been made to the County Commissioners for a franchise to construct and operate an electric railway through the Grand Coulee.

ELKINS, W. VA.—The Elkins Power Company is building an entire new plant, the equipment of which will consist of two 250-kw, 3-phase, 60-cycle, 2300-volt, General Electric units. Engines and boilers have not yet been contracted for. It is expected to have the plant in operation about Nov. 1. This company is successor to the Valley Improvement Company. N. I. Hall is secretary and treasurer.

WHEELING, W. VA.—Bids will be received by Captain F. W. Alstaetter until Aug. 31 for the construction of power house at Dam 13, Ohio River.

CEDARBURG, WIS.—Plans are being considered to increase the equipment of the municipal electric light plant, including the installation of a new 200-hp steam turbine and a 100-kw generator. Ernest E. Schneider is superintendent.

IOLA, WIS.—Frogner Brothers & Sons are contemplating the construction of a new plant and extending their transmission lines. O. G. Frogner is manager.

SHAWANO, WIS.—An additional dynamo will probably be installed in the municipal electric light plant. Charles McCarter is superintendent.

CALGARY, ALB., CAN.—The Montreal Engineering Company, Montreal, Que., is considering a proposition to build an electric street railway system in this city.

CALGARY, ALB., CAN.—Owing to the increase in demand for electricity, the city has found it necessary to increase the equipment of the municipal electric light plant. A contract has been placed with the Allis-Chalmers-Bullock Company, of Montreal, Que., for a 750-kw, engine type alternator; 30-kw, exciter generator, switchboard and other auxiliary apparatus.

EDMONTON, ALB., CAN.—The City Council is considering a proposition for the immediate construction of an electric railway system here and in Strathcona, on the opposite side of the river. For further information address Mayor Macdougall.

EDMONTON, ALB., CAN.—A further reduction of three cents per kw-hour has been made by the city to consumers of electricity for lamps. Also a reduction of one cent per kw-hour has been made in the price of electricity for motors and in future the minimum charge for electricity for lamps will be 50 cents per month instead of 75 cents. At the end of 1907 the civic power plant showed a surplus of $38,000.

LETHBRIDGE, ALB., CAN.—The City Council has adopted the recommendation of the special committee to purchase the plant of the Lethbridge Electric Company. The city proposes to remove the plant to the pumping house site, where it will be enlarged and improved and the whole system extended, involving an expenditure of about $150,000.

NELSON, B. C., CAN.—The city has taken over the civic power plant at Bonnington Falls from the contractors, the Allis-Chalmers-Bullock Company, of Montreal, Que.

KILLARNEY, MAN., CAN.—George Collison, of Estevan, Sask., has received a bonus from the Town Council to install an electric light and power plant in this town.

WINNIPEG, MAN., CAN.—Proposals will be received by the city of Winnipeg until Sept. 15 for electric lighting plant and carbons. For further information address F. A. Cambridge, city electrician, or M. Peterson, secretary Board of Control.

YARMOUTH, N. S., CAN.—The Yarmouth Street Railroad Company is making arrangements to construct a large dam at Nine Partners Falls.

BOBCAYGEON, ONT., CAN.—The question of building a new flume and power house for the municipal electric light plant is under consideration. F. S. Burroughs is chief engineer.

BRANTFORD, ONT., CAN.—The City Council has voted to expropriate the electric plant and street lighting system of the Western Counties Electric Company. The city has endeavored to get the company to sell out its entire plant and to supply electricity until such time as the lines of the Hydro-Electric Power Commission were built. The company is now lighting the streets of the city at the rate of $55 per arc lamp per year, the contract for which expires in September. The company wants $37,000 for its equipment, and it is expected that the question will be submitted to a board of arbitration.

FORT FRANCIS, ONT., CAN.—Construction work has been resumed on the dam in connection with the power plant development here by the Backus-Brooks syndicate, of Minneapolis, Minn. The work will cost $700,000 and will take another year to complete it.

MERRITTON, ONT., CAN.—The Town Council has engaged K. L. Aitken, of Toronto, electrical engineer, to prepare a report on the purchase of power and other matters in connection with the proposed municipal electric light plant.

SHERBROOKE, ONT., CAN.—The city and light department has placed an order for a 400-kw generator for the municipal electric light plant. The city purchased the property of the Sherbrooke Power, Light & Heat Company May 1, 1908. A. Sangster is superintendent.

TOTTENHAM, ONT., CAN.—Improvements are being considered for the municipal electric light plant, which include the installation of a storage battery and placing new poles and erecting heavier wire for transmission. J. H. Sloan is superintendent.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Aug. 31, for furnishing cable railways with grip cars, electric railways with motor cars, traveling cranes, etc. Blanks and general information relating to circular No. 460 may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal. Also from the U. S. engineer offices in the following cities: Seattle, Wash.; Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; Mobile, Ala., and Galveston, Tex.; Commercial Club, Kansas City, Mo.; Chamber of Commerce, Quincy, Ill., and Chamber of Commerce and Board of Trade, Tacoma, Wash. Captain F. C. Boggs is general purchasing officer.

New Incorporations.

CARTHAGE, ARK.—The Grant & Dallas County Telephone Company has been formed, with a capital stock of $25,000 by R. E. Harrison, president; T. E. Bell and P. G. Bell.

EUDORA, ARK.—The Eudora Gin, Water & Light Company has been incorporated with a capital stock of $8,000 and the following officers elected: M. Schwartz, president; A. E. Allen, vice-president; H. M. Bailey, secretary, and A. Fiebleman is treasurer.

CHICAGO, ILL.—The Centralia & East St. Louis Traction Company has been incorporated with a capital stock of $30,000 to construct an electric railway from Vincennes, Ind., through the counties of Lawrence, Richland, Clay, Marion, Clinton or St. Clair. The incorporators are: J. J. Burns, Dennis O'Connor and J. E. Burns.

BLOOMFIELD, IA.—Articles of incorporation have been filed for the Bloomfield Telephone Company, with a capital stock of $20,000, and the following officers have been elected: G. E. McFarland, president; C. E. Hall, vice-president, and W. J. Steckel, secretary and treasurer.

COLFAX, IA.—Articles of incorporation have been filed for the Colfax Springs Railway Company with a capital stock of $25,000 to build an electric railway from Colfax to Colfax Springs, a distance of about two miles. The officers of the company are: Frank B. Hooper, president; James P. Donahue, vice-president and treasurer, and John W. Martin, secretary.

AMERICUS, KAN.—Articles of incorporation have been filed for the Americus Mutual Telephone Company, with a capital stock of $10,000.

REPUBLIC, KAN.—The Citizens' Telephone Company has been incorporated, with a capital stock of $10,000, to install a telephone system at Republic.

GLENDEANE, KY.—The Taylor Creek Telephone Company has been organized to erect a telephone line from Taylor Creek to Glendeane, a distance of about 22 miles. The company is capitalized at $1,000 and the incorporators are D. J. Gayle, M. B. Gayle, Ira Smith, of Taylor Creek.

LOUISVILLE, KY.—Th Mulberry Flat Telephone Company has been incorporated, with a capital stock of $2,500. The incorporators are W. W. Taylor, T. H. Rhodes, C. M. Kelley and others.

EASTON, MAINE.—The Easton Electric Company has been incorporated with a capital stock of $3,200 by C. N. Delaite and C. W. Spear, of Easton.

WALLED LAKE, MICH.—The Walled Lake Home Telephone Company has been incorporated. The officers are: George Dickerson, president; George Tuttle, secretary, and A. J. Church, treasurer.

Company Elections.

NASHUA, N. H.—At the annual meeting of the Nashua Light, Heat & Power Company the following-named officers were elected: F. W. Estabrook, president; Elbert Wheeler, treasurer, and James H. Tolles, clerk.

FISHKILL, N. Y.—At the annual meeting of the Southern Dutchess Gas & Electric Company the following named officers were elected: John T. Smith, president and treasurer; C. H. Watson, vice-president, and S. K. Phillips, secretary.

CLAREMONT, N. H.—At the annual meeting of the Claremont Railway & Lighting Company the following officers were elected: W. L. Moran, president; L. N. Wheelock, general manager; Thomas Steere, treasurer, and O. B. Rand, auditor.

LEE, MASS.—At the annual meeting of the Lee Electric Company the following officers were elected: Bennett T. Gale, president; Carl Wurtzbach, secretary and treasurer. The board of directors is composed of J. C. Chaffee, J. L. Kilbon, B. T. Gale, E. L. Murphy and Carl Wurtzbach.

New Industrial Companies.

THE RICE ELECTRIC DISPLAY COMPANY, of Dayton, Ohio, has been incorporated with a capital stock of $500,000 by Elwood E. Rice and others.

THE SOUTHERN ILLINOIS ELECTRIC COMPANY, of St. Louis, Ill., has been chartered, with a capital stock of $6,000, by Ira L. Pendleton, Harry M. Bean and others.

THE ELECTRICAL REVOLVING TOWER ADVERTISING COMPANY, of Montgomery, Ala., has been incorporated, with a capital stock of $500,000, by G. G. Miles, L. Lasseter, W. E. Holloway, of Montgomery, Ala.

THE AMERICAN ARC LAMP COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $15,000, and the following directors: William L. Levy, Eugene E. Spiegelberg and Jerome A. Jacobs, of New York, N. Y.

THE MEAD COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000, for the purpose of manufacturing electric cleaning machines, etc. The incorporators are Zelma B. Mead, Joseph A. McAnerney, of New York, N. Y.; Harold M. Wilcox, of Mt. Vernon, N. Y.

Personal.

DR. JAMES T. ROOD, professor of electrical engineering at the University of Alabama, was married on July 29 to Miss Myrtle Merrill, at Tuscaloosa, Ala.

MR. C. E. F. AHLM, of the Caxton Building, Cleveland, Ohio, has been retained by the Board of Public Service, of Wooster, Ohio, as consulting engineer in connection with the proposed municipal electric lighting plant for that city.

MR. J. AUERBACH, president of the Electrical Accessaries Company, 1135 Broadway, New York, has just returned from Germany. He found the German electrical manufacturers quite busy, the makers of tungsten lamps being especially rushed with orders.

MR. WALTER P. SCHWABE, local superintendent at Rutherford, N. J., of the gas and electrical department of the Public Service Corporation of New Jersey, has resigned to accept the position of general manager of the Northern Connecticut Light & Power Company, at Windsor Locks, Conn.

MR. E. H. MATHER, of Boston, Mass., has become the general manager of the Nassau Light & Power Company, one of the largest systems on Long Island, New York. This system has been built up and developed by J. G. White & Company, of New York City, as described in these pages, and is a good example of modern light and power development.

MR. WM. T. THOMAS, for some time past manager of the Rumsey Electric Company, Ltd., of Philadelphia, has resigned that position to became assistant manager of the H. T. Paiste Company, of Philadelphia. Previous to his connection with the Rumsey Company Mr. Thomas was for nine years associated with the H. C. Roberts Electric Supply Company, of Philadelphia, and successfully managed the commercial side of that business. Mr. Thomas assumed his new duties on July 1, 1908.

Obituary.

MR. THEO. DIMON died in Utica, N. Y., a few days ago, at the age of 32 years. He was graduated from Cornell University in 1898, and afterward received a commission as assistant engineer in the United States Navy. He resigned this position and was afterward connected with the Bossert Electric Construction Company, Utica, N. Y., and the Western Electric Company at Chicago. He was an associate member of the A. I. E. E.

MR. J. V. S. CHURCH.—It is with deepest regret that we record the sudden death of Mr. J. V. S. Church, who for nearly fourteen years had been the loyal and successful Western representative of Electrical World. He succumbed to the intense heat in Chicago last week, which brought on an attack of heart disease. On July 28, Mr. Church felt quite unwell, and went home in the early afternoon, but wrote a business letter while there. He then felt so ill he took to his bed, and his condition changed rapidly for the worse, with no hope of recovery, although the best medical skill was employed. He died on the morning of July 29 and was buried two days later in Graceland Cemetery after a coroner's inquest. The deceased, who was but little over 45 years of age, came to this country with a party of other well-educated, well-to-do young Englishmen in the early days of the great iron boom in the South a score of years ago. He put a large sum of money into the construction of a railroad in Alabama, tapping the Sheffield and Birmingham ore beds, but the following panic wiped out his fortune completely. With sturdy courage Mr. Church began life again, getting work in the railroad field, and through the kindness of Sir George Pullman, whom he knew, securing a good position as a Pullman car conductor. Among the friends he made was Col. J. H. Shay, the well known belting man, who recommended him warmly to Mr. W. J. Johnston, the publisher of the Electrical World, by whom he was engaged forthwith to represent the paper, although he had had absolutely no journalistic experience. It is an interesting coincidence that at about the same time Mr. J. H. McGraw, had formed a favorable opinion of him and was proposing to secure his services. Mr. Church made a distinct hit in his new line of work, and built up for himself a friendship and a journalistic connection throughout the central West that certainly was never surpassed, enjoying the warm esteem and thorough confidence of all the leaders in the electrical field. He visited New York for a business confidence about a month ago, and complained then of feeling the effects of the weather; but no one imagined anything serious was the matter. Mr. Church was a man of great force and strongly marked characteristics, a pronounced Englishman in every way, but he was also a born diplomat, a charming companion, and a most vigilant and energetic representative of the publishing interests that now grieve over the loss of his admirable services. Mr. Church married in Chicago a few years ago, and he is survived by Mrs. O. E. Church, to whom in her bereavement a host of friends have expressed their sorrow and sympathy.

J. V. S. CHURCH.

Legal.

COMPANY FREE FROM LIABILITY WHERE POLE IS BLOWN BY SEVERE STORM.—An action was brought against a telephone company for damages to a building resulting from the alleged negligence of the telephone company in erecting an unsafe and insecure pole. The pole in question was erected on the edge of the sidewalk and ran up through the plaintiff's awning. It was 50 feet long, 20 inches in diameter, and was placed 6 feet in the ground. At the time it was put up, three years before the injury, it was inspected and was found to be in good condition. The defense was that the pole was sound and was properly stayed and guyed, and that the damage complained of was the result of an act of God in the form of a storm of extreme violence. It was shown that a severe wind storm broke the pole off just above the awning, the upper part remaining suspended by the wires which were attached to it. The front of the plaintiff's building was either pulled down by the wires which ran over it or was battered down by the suspended pole. It was held that the storm was of such unprecedented violence as to come within the category of occurrences denominated the Act of God, for which the company could not be held liable. Southwestern Telegraph & Telephone Co. v. Ingrando, 27 Tex. Civ. App. 400, 65 S. W. 1085.

Trade Publications.

INEXPENSIVE LIGHTING FIXTURES.—The Central Electric Company, Chicago, Ill., is distributing a new edition of the bulletin entitled "Inexpensive Lighting Fixtures," which is of interest to central stations, especially the section referring to tungsten fixtures. A feature of the bulletin is the harmony of detail in the plain and artistic designs reproduced therein.

LIGHTNING PROTECTION.—Bulletin H of the Lord Electric Company, of New York and Boston, contains information and data on its various types of lightning arresters and accessory equipment. Methods for grounding, descriptions of various kinds of choke coils, disconnecting switches, etc., form part of the bulletin, which is well illustrated. The new horn-gap type of arrester brought out by the company is also shown.

LAMP TESTING WATT INDICATOR.—A practical demonstration of the efficiency of the new metallic filament incandescent lamps will often aid in their introduction, particularly with prospective customers. A small instrument known as a lamp testing watt indicator has just been placed on the market by the General Electric Company, Schenectady, N. Y., designed for the purpose of giving a practical demonstration of the relative watt consumption of metallic and carbon filament lamps. This instrument is intended for use with Edison base lamps, but can be provided with an adapter permitting its use with either Thomson-Houston or Westinghouse socket or lamp base. The instrument is of the portable type and can be carried in the pocket. It is fully described in Bulletin No. 4609.

AUTOMATIC VOLTAGE REGULATORS.—The General Electric Company, Schenectady, N. Y., is issuing two bulletins describing its improved automatic voltage regulators for alternating-current and direct-current generators. They are made in various styles for the regulation of the voltage of one generator or of two or more in parallel. Among the advantages secured by such voltage regulation are the use of lamps of higher efficiency, reduction of lamp renewals, saving in energy, and the decrease in the number of switchboard attendants necessary. Bulletins Nos. 4601 and 4602 describe the regulators for alternating and direct current generators respectively, and contain diagrams showing the various connections and arrangements of the different styles of voltage regulators.

THE CENTRAL ELECTRIC COMPANY, Chicago, has just issued a very attractive 32-page bulletin on lighting fixtures, showing a complete line for various classes of illumination, one section being devoted to tungsten lamp fixtures. Special attention is called to the fact that the fixtures are produced by their new factory organization. This insures uniform product and prompt shipments, an important feature for those having "rush jobs" in the line of "boxed" fixtures comprising certain *standard* lines carried in stock for 24-hours shipment. Attention is also called to the fact that customers have the advantage of a complete factory organization for the manufacture of lighting fixtures; a designing department which is constantly producing new and unusual designs, and the services of experienced men to take up the manufacture of special fixtures to meet various special conditions arising when working out the problem of properly illuminating a given space. This new catalogue will be sent to any address upon request.

Business Notes.

AMERICAN STEAM GAUGE & VALVE COMPANY.—J. B. Kane, who has had several years' experience in the factory of the American Steam Gauge & Valve Manufacturing Company, has been promoted to the position of salesman and will make his headquarters at the New York branch of the company.

THE ELECTRIC ACCESSARIES COMPANY, 1135 Broadway, New York, is importing from Germany a large number of tungsten lamps of 25, 40 and 100 cp. The anchorings of these lamps embrace many new features enabling them to burn in all positions. The officials of the company say that their business is very satisfactory at present.

GLASS-BLOWING AND THERMOMETERS.—Scientific glass-blowing, vacuum specialties and electrical thermometers are some of the work that is turned out by Wm. Hiergesell, 946 Gates Avenue, Brooklyn. Mr. Hiergesell and his associates have had a large experience in this line and number among their customers many in the electrical field.

F. A. LAWSON & COMPANY, of San Francisco, report increasing popularity of Dossert Solderless Connectors on the Coast. They have orders for these devices from the following companies; Los Angeles Gas & Electric Company, San Diego Gas & Electric Company, and Siskiyou Electric Power Company; the Cowell Portland Cement Company; Hunt, Mirk & Company; James Stewart & Company, of San Francisco, and the American Beet Sugar Company, of Oxnard, Cal.

WESTERN ELECTRIC COMPANY.—The Western Electric Company has recently established an apparatus department in its new branch house at Dallas, Tex., in charge of Mr. W. L. Green, who has been for several years connected with the sales organization in Chicago and St. Louis. The territory covered by the Dallas house comprises all of Texas and the northern portion of Old Mexico, and the establishment of this department may be taken as an indication of the growth and possibilities in that section along electrical lines.

ENLARGED PLANT FOR AMERICAN DISTRICT STEAM COMPANY AT TONAWANDA.—On Friday, July 24, the American District Steam Company, of Lockport, N. Y., suffered the loss by fire of a portion of its Tonawanda plant where is located its casing mill and foundry. Plans are made for rebuilding the burned portion on an enlarged scale, which is to be of fireproof construction as nearly as may be. The company informs us that its business for the season will not be delayed.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 28, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Att'ys, 41 Park Row, N. Y.]

894,193. INCANDESCENT LAMP. William W. Dean, Chicago, Ill. App filed Aug. 9, 1902. In a small incandescent lamp, the combination with a cylindrical bulb, of a pair of terminal strips mounted upon the sides of said bulb, said terminals continuing beyond the end of the bulb to the end of the base and forming a portion of its outer surface, said strips having longitudinal ridges formed therein to form an engaging surface for the jack springs, substantially as described.

894,199. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Ralph M. Gaston, Morgan Park, Ill. App filed Nov. 29, 1907. Provides means whereby the operation of an electric motor is conditioned by the position of another electric motor or device. Has means made effective by and at certain periods in the operation of the second motor, to open and close the auxiliary circuit.

894,201. INSULATOR; Thomas E. Hallett, Chicago, Ill. App. filed Jan. 8, 1903. An insulator support including a bent metallic bar adapted to enter the insulator, and a single wedge block engaging the same and the threads of the insulator bore.

894,212. TROLLEY GUARD; George S. Keck, Baltimore, Md. App. filed Aug. 12, 1907. The patentee has a pair of rollers pivoted in a horizontal plane on the usual harp to close over the usual wheel and wire.

894,214. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed April 24, 1907. Relates to telegraphy over lines of great capacity, such as submarine cables. Has means to prevent the movement of the zero line.

894,217. ELECTRIC RAILWAY; Mathias A. Lazareff, New York, N. Y. App. filed Feb. 6, 1907. Signal system making use of specially constructed tappets along the roadway, adapted to close the circuits of semaphores having a special construction of operating magnets.

894,232. MOTOR CONTROLLING SYSTEM; Walter J. Richards, Norwood, Ohio. App. filed Sept. 29, 1906. A motor system for printing presses, designed to permit a very slow speed and stop the press without shock. Has means whereby, in case there is conflict between two or more operators at different controllers, the slow control will alone be operative.

894,233. SYSTEM OF MOTOR CONTROL; Walter J. Richards, Norwood, Ohio. App. filed Jan. 31, 1907. Relates to modifications of the above.

894,237. MEANS FOR CHARGING STORAGE BATTERIES; William D. Stivers, of Jersey City, N. J. App. filed March 27, 1907. Relates to details of a controlling device, whereby the storage batteries are charged with proper current density during the entire charging action.

894,238. ACCUMULATOR-ELECTRODE; Ludwig Strasser, of Charlottenburg, Germany. App. filed Aug. 20, 1904. Includes graphite in the form of scales mixed with carbons of poor quality to improve their conductivity.

894,257. TELEPHONE APPARATUS; Arthur M. Cobb, Lynn, Mass. App. filed Nov. 4, 1907. In a telephone apparatus a structure adapted to be secured to the head, said structure comprising two annular members, and a receiver provided with a projection located between said annular members.

894,258. TELEPHONE APPARATUS; Arthur M. Cobb, Lynn, Mass. App. filed Jan. 18, 1908. In a telephone apparatus a structure adapted to be secured to the head, a receiver supported on said structure, a transmitter support, a universal joint connecting said support to said structure, means adapted to hold said joint in fixed position and a transmitter mounted in said support.

894,273. WINDING MACHINE; John H. Lendi and Albert H. Simmons, Chicago, Ill. App. filed July 26, 1907. Automatic winding machine adapted to wind strand material upon a core and adapted to automatically dispose the strand material in layers. Includes a winding spindle, a reciprocating guide, and a pneumatic paper carrier.

894,284 ALARM; Edward Pfeifer, Columbus, Ohio. App. filed Feb. 25, 1908. Means whereby escaping gas or water will be indicated by a bell. Has a pair of balanced pans which are tilted in case water is collected therein.

894,304. FIRE-ALARM BOX; Leonidas G. Woolley, Lima, Ohio. App. filed Aug. 31, 1906. A fire-alarm box adapted to be operated by a person at the box or by a distant electro-magnetic generator, as from a residence within the fire district.

894,305. TURBO-GENERATOR; Alfred H. Wouters, Norwood, Ohio. App. filed Nov. 3, 1906. Dynamo-electric machines for use with turbo generators. Has radiating laminations in planes axial of the armature between which the conductors are secured.

894,317. ELECTRODE FOR ELECTROLYTIC OR LIQUID OSCILLATION DETECTORS FOR WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed Dec. 21, 1905. Includes a flat plate of conducting material fused into a glass receptacle and having special structural characteristics.

894,318. AEROPHORE; Lee De Forest, New York, N. Y. App. filed Dec. 22, 1905. A system whereby two moving trains, each provided with transmitting and receiving systems, may each communicate warning or direction indicating signals. Operates by wireless emanations between the trains.

894,323. ELECTRIC WATER HEATER; Frank E. Holt, Vancouver, British Columbia, Canada. App. filed April 2, 1908. A water heater of the type having a cylindrical tube through which the water flows, and which contains a zig-zag resistance element strung between insulating notched bars.

894,326. ELECTRIC SWITCH REGISTER; John H. Jackson, Watonga, Okla. App. filed Feb. 18, 1908. The patentee has a specially constructed tappet adjacent to the switch point, and which closes an electric alarm circuit in case the switch point is open.

894,329. ELECTRIC GENERATOR OR MOTOR; Carlton L. Kennedy, Braintree, Mass. App. filed July 29, 1905. Construction of machine adapted to be operated as a multi-speed motor or as a multi-voltage generator, or as a motor-generator driven by an outside source of current.

894,333. ELECTRICALLY PROPELLED VEHICLE; Joseph Ledwinka, Philadelphia, Pa. App. filed May 19, 1906. Has means to automatically change the circuit connections of a motor vehicle from an external to an internal source of supply and conversely, whereby the motor is always in communication with one source of energy.

894,378. WIRELESS SIGNALLING APPARATUS; Lee De Forest, New York, N. Y. App. filed Jan. 17, 1903. Includes a plurality of wave producers each having a period differing from the others, and a receiving apparatus having a plurality of supplemental wave respon-

sive devices, and an indicating device connected with all of said wave responsive devices.

894,382. CONTACT SWITCH BOX FOR ELECTRIC RAILWAY SYSTEMS; Charles A. Huse and John G. Douty, Williamsport, Pa. App. filed Sept. 17, 1907 A contact switch box of the class for use with railways, having contact plates at spaced intervals, in place of continuous conductors. Has an armature supported in a certain way to operate the switch of the device.

894,435. ELECTROLYTIC APPARATUS FOR PURIFYING LIQUIDS; John T. Harris, New York, N. Y. App. filed July 9, 1906. A tank contains a plurality of spaced-apart plates between which the water flows, and which are electrified to alternate polarity so as to thoroughly act upon the water electrolytically.

894,460. TELEPHONE-TRANSMITTER; Emile J. Pitrat, Urbana, Ill. App. filed June 21, 1907. In a transmitter of the character described, a speaking diaphragm, and a button containing comminuted material, vibratively connected with the said diaphragm and arranged in a vertical position at right angles to the diaphragm whereby the latter may be tilted without affecting the vertical position of the button.

894,468. TANK INDICATOR; Julius E. Smith, of North Lansing, Mich. App. filed Dec. 12, 1907. A tank indicator of the class closing an electric circuit when the liquid rises above a predetermined level. Includes a spring-operated plunger normally depressed by a heavy float which rises when the water reaches a predetermined level.

894,471. RAILWAY SIGNALING; Jacob B. Struble, New York, N. Y. App. filed July 13, 1904. Signaling system in which automatic tripping devices are located along the railway, which in their set position operate a train stop. The train stops are set by semaphore signals operated by the short circuiting of the track rails which are energized by a direct current.

894,476. RAILWAY SAFETY APPLIANCE; Charles A. Ward, Forestville, Conn. App. filed May 29, 1907. The locomotive has depending shoes which engage interrupted trolley conductors between the track rails which are connected in lamp circuits so as to be exhibited along the roadway.

894,479. INDUCTION COIL; Amos R. Bliss, Lowell, Mass. App. filed April 13, 1908. The induction coil is made in entirely separable sections with plates which contact with one another when the sections are assembled, so as to be removable whenever desired.

894,482. PLATING MACHINE; Seth C. Catlin, Bloomfield, N. J. App. filed March 12, 1907. Electroplating machine having a casing provided with baskets capable of rotary motion, whereby the deposition is made subject to the burnishing action of the fluid electrolyte.

894,487. PRIMARY BATTERY; Eben G. Dodge, Newark, N. J. App. filed April 29, 1907. The negative electrode consists of a plate of oxide, of copper or other depolarizing agent properly molded and agglomerated. The positive electrode consists of a zinc plate.

894,518. LIGHTNING ARRESTER; Maurice Milch, Nagy Bittse, Austria-Hungary. App. filed Jan. 16, 1907. In a lightning arrester a plurality of conductors of different material disposed to form a plurality of air gaps having a greater resistance to the flow of current in one direction than in the other.

894,522. VOLTAGE REGULATING DEVICE; Wilbur L. Merrill, Schenectady, N. Y. App. filed Oct. 27, 1906. A controlling system for lighting circuits in theaters. Has relays operatively connected to the individual field rheostats and adapted to disconnect a conductor of each of the circuits from one source and connect it to another.

894,533. DYNAMO-ELECTRIC MACHINE; Henry G. Rest, Schenectady, N. Y. App. filed Nov. 11, 1907. A ventilating means for armatures, including clips bent so as to have radially projecting blades which produce a strong air circulation in the rotation of the armature.

894,539. REGULATION FOR MULTIPHASE SYSTEMS; Edward Schildhauer, Washington, D. C., and Albert A. Radtke, Chicago, Ill App. filed Feb. 8, 1907. Provides a system adapted to automatically regulate the various circuits of a multiphase alternating-current system. Eliminates the usual motor generator.

894,547. APPARATUS FOR MANUFACTURING NITROUS COMPOUNDS; Charles P. Steinmetz, Schenectady, N. Y. App. filed March 19, 1907. The combination with an air chamber of a high-tension circuit or circuits traversing the same and having air gaps in series with the chamber, means for establishing electric arcs in the air gaps, and means for lengthening and breaking the arcs, substantially as described.

894,563. STARTING RHEOSTAT; William C. Yates and George W. Cravens, Schenectady, N. Y. App. filed Nov. 9, 1905. Relates to the starting of single-phase motors of the induction type. Has means whereby the starting arm, which is initially biased to off position, has its bias changed so as to be biased toward running condition, so that, if the operating handle should be released when the starting conditions are established, the arm will not return to off position, but will go over to running condition.

894,564. RHEOSTAT; William C. Yates, Schenectady, N. Y. App. filed Dec. 10, 1907. Relates to modifications of the above.

894,565. RHEOSTAT; Paul H. Zimmer, Schenectady, N. Y. App. filed Dec. 26, 1907. Has means in connection with an electro-magnetic switch for closing the main circuit, or opening said switch upon the occurrence of overload conditions. Also has means whereby the switch may be automatically opened on the return of the controlling arm to starting position.

894,591. SEMAPHORE SIGNAL; Walter A. Brown and Arba G. Clark, Schenectady, N. Y. App. filed March 21, 1907. Construction of semaphore signal of the "top-post" type, in which the operating mechanism is enclosed in a casing surrounding the drive shaft of the semaphore arm. Designed to reduce the size and cost of these signals.

894,593. WIRE STRINGING DEVICE; John G. Callan, Nahant, Mass. App. filed Sept. 16, 1907. Means for supporting a wire or the like as it is conducted along in the process of treatment, as, for instance, coating with insulating material. Includes a system of pulleys and tension devices.

894,602. SECONDARY OR STORAGE BATTERY; Charles H. Clarke, Stratham, N. H. App. filed Sept. 28, 1907. Has a number of independent porous plates carrying or holding alongside the electrodes an active material, and between which an exciting fluid is admitted.

894,613. PROCESS OF INSULATING ELECTRIC CONDUCTORS; John T. H. Dempster, Schenectady, N. Y. App. filed Nov. 6, 1907. Process of insulating an electrical conducting alloy, which consists in heating the same in an oxidizing atmosphere and then treating it to remove part of the oxide.

894,614. RHEOSTAT; George H. Dorgeloh, Schenectady, N. Y. App. filed Jan. 11, 1908. A starting rheostat having two resistances and a pair of controlling arms in which the field controlling arm is mechanically locked against movement until the starting arm is moved to running or short-circuited condition.

894,616. INSULATOR AND WIRE CLAMP; John L. Fay, St. Louis, Mo. App. filed Sept. 19, 1907. A form of insulator having a cavity at its top in which the conductor is depressed by a set screw in an overlying bracket.

894,620. TRANSFORMER; John J. Frank, of Schenectady, N. Y. App. filed Oct. 17, 1907. Has two current transformers, each having two windings, one of which consists of a single turn, the single-turn windings being connected in series.

894,622. GAS AND GASOLINE ENGINE; Anthony Fricker, of Pittsburg, Pa. App. filed Oct. 24, 1906. Means for timing the spark in an explosion engine, including a centrifugal governor with link connections to the commutator segment, by which the position of the same is varied.

894,624. MAGNETO-ELECTRIC GENERATORS; Louis Alexandre Gianoli, Paris, and Raoul Andre Persin, Villiers-le-Bel, France. App. filed April 12, 1905. In place of the commutator, the patentee has a magnetically attracted vibrator forming part of the armature of the generator, and which opens its circuit when a predetermined saturation is obtained.

894,625. INCANDESCENT LAMP; Emery G. Gilson, Schenectady, N. Y. App. filed Dec. 22, 1906. Has a filament and a stem having a sealing cap, and removable means for clamping said filament to said cap.

894,637. TROLLEY CONTACT; Laurence A. Hawkins, Schenectady, N. Y. App. filed Dec. 31, 1907. A trolley contact comprising a long, flat, flexible, continuous strip of conducting material supported directly above the trolley wire, and adapted to be engaged by the rims of the flanges of a trolley wheel in passing.

894,643. CONTACTOR; George H. Hill, Schenectady, N. Y. App. filed Dec. 31, 1903. A contactor employed in systems of motor control of the separately actuated contact type under the control of a master controller.

894,644. BUSLINE COUPLING SOCKET; George H. Hill, Schenectady, N. Y. App. filed Oct. 1, 1904. A coupling for the bus-bar and pilot circuit connections of a train, adapted to operate in a manner analogous to air-hose couplings.

894,645. CONTACTOR; George H. Hill, Schenectady, N. Y. App. filed Feb. 9, 1906. Power operated circuit switches or contactors in motor control systems, having a solenoid which impells the contacts into an engagement in a conical chamber, and adapted to blow out the arc which is formed at the circuit rupture.

894,651. METER; Charles E. Holmes, Lynn, Mass. App. filed May 6, 1905. A design of an electric meter in which all of the metallic parts are formed of sheet metal stampings of cheap construction.

894,668. SYSTEM FOR ELECTRICAL DISTRIBUTION; Osias O. Kruh, of Schenectady, N. Y. App. filed Feb. 15, 1907. The combination of a load circuit, a vapor arc rectifier delivering current thereto, anodes for said rectifier, and means for varying the voltage on said load circuit by shifting the vapor arc from one pair of anodes to another.

894,703. FLUSH RECEPTACLE AND PLUG; Frank W. Sanford, Schenectady, N. Y. App. filed Sept. 12, 1905. Connectors for electric circuits of the type in which a receptacle containing main line terminal contacts is let in flush with a floor or wall, while the terminal contacts of the branch line are carried on a plug, adapted to be thrust into the receptacle in such a position as to bring the two sets of contacts together and connect the main line with the branch line.

894,704. COMBINED FUSE BOX AND RECEPTACLE; Howard R. Sargent, Schenectady, N. Y. App. filed Oct. 1, 1907. Thermal cut-out adapting a main circuit to be led off from a branch circuit with suitable protecting devices, so as to be readily accessible for replacement without the use of any tools.

894,705. PROTECTIVE DEVICE; Ernest Schattner, Schenectady, N. Y. App. filed June 10, 1905. Has a shunt connection between the conductors of an electric consumption circuit, having an automatic cut-out device, said shunt connection having a section of resistance material of negative temperature coefficient.

894,714. VARIABLE VOLTAGE TRANSFORMER; Mercer G. Young, of Pittsfield, Mass. App. filed Dec. 26, 1907. Has means for changing the flux which is due to the primary winding, passing through the secondary winding, and means for decreasing the reactance of the secondary winding.

894,720. METHOD OF FORMING BOND RAILS; Eugene M. Bournonville, Jersey City, N. J. App. filed Dec. 30, 1907. A form of bond adapted to be soldered or fastened upon the base flanges of the rail. Covers the method by which the contact is made by pouring molten solder into cavities of the bond.

894,723. ARRESTER; Albert Bishop Chance, Centralia, Mo. App. filed Sept. 12, 1906. A lightning arrester having a spiral wire in a cylindrical casing, and a stud in proximity thereto, across which the lightning discharge takes place.

894,741. GALVANIZING SHEET METAL; Carl Lebert, Ernst Roskothen and Karl Wirth, Ludwigshafen-on-the-Rhine, Germany. App. filed Nov. 8, 1907. A device for galvanizing sheet metal on the entire surface without the use of separators, so that the cathodes and anodes are free over their whole surface.

894,760. TROLLEY BASE; Charles M. Stokes and William F. Ensor, Bradford, Pa. App. filed Sept. 23, 1907. Improvements in trolley bases, designed to provide a swiveled pole support of special simplicity. Has a spring plunger with a link connection to the pole socket.

894,766. MEANS FOR OPERATING VAPOR ELECTRIC LAMPS; Ezechiel Weintraub, Schenectady, N. Y. App. filed Dec. 26, 1902. The combination of a plurality of vapor electric lamps, connections interlinking said lamps in series with each other, a resistance in shunt to each lamp, and a cutout responsive to flow of current in the lamp for interrupting the circuit of said resistance.

894,782. ELECTROMECHANICAL DEVICE; George H. Rowe, Riverside, Ill. App. filed Oct. 15, 1906. Means for cushioning a blow resulting from the movement of a mechanically reciprocated member. Has a series of annular poles acting on an armature attached to the reciprocating part.

894,783. BRANCH BLOCK; Howard R. Sargent, Schenectady, N. Y. App. filed July 13, 1906. A branch block by which the respective conductors are effectually insulated from each other, and accidental exposure of any conductor rendered unlikely. Includes a pair of porcelain blocks assembled together so as to enclose the interior metallic parts therebetween.

894,790. MANUFACTURE OF COVERED WIRE; Charles V. Ackerman, Passaic, N. J. App. filed June 11, 1906. A complete machine for coating or insulating wire with a plastic substance enclosed in a wrapper of sheet tin, the wrapper serving as a mold for the plastic substance in the subsequent vulcanizing process.